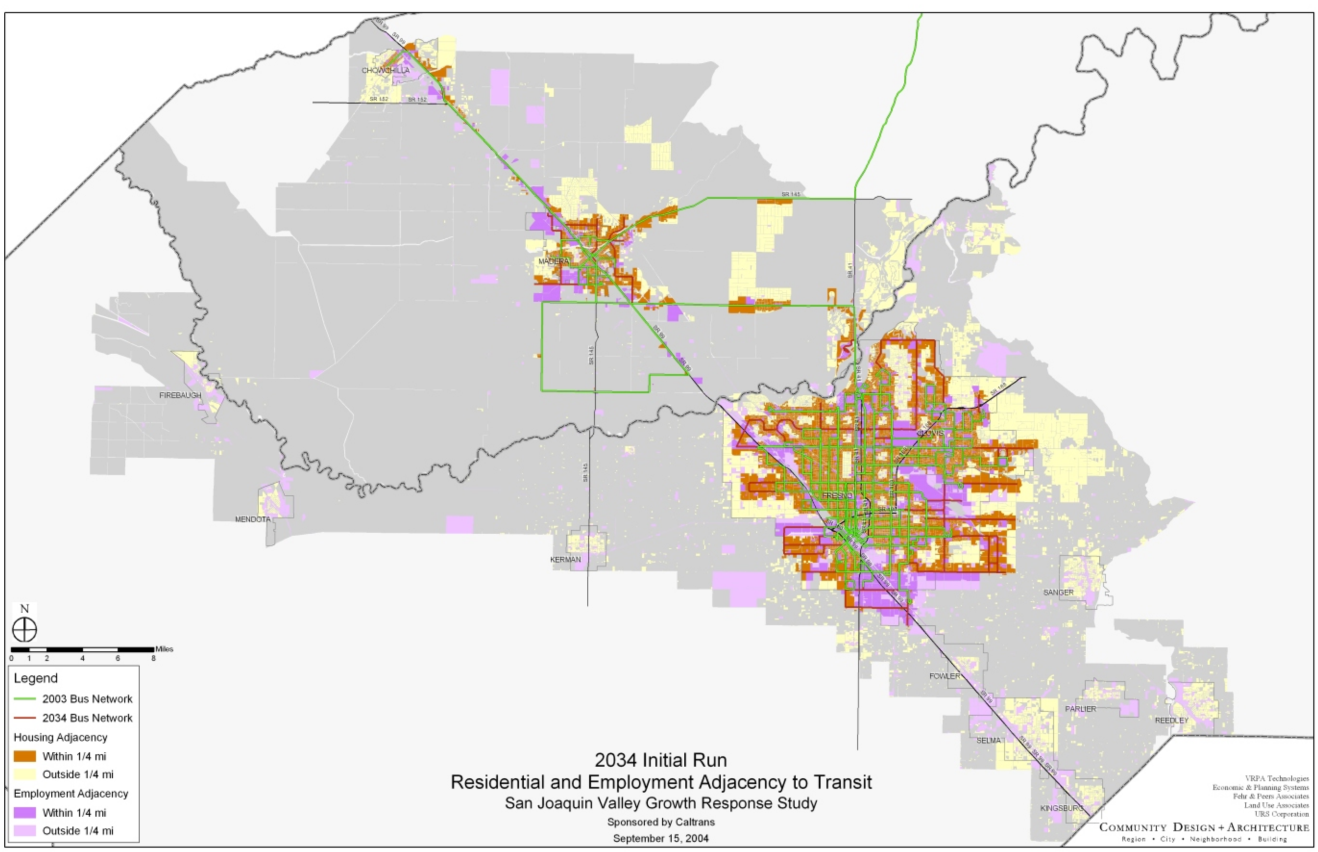
San Joaquin Valley Growth Response Study, Phase III

Fresno - Clovis Southeast Madera Region

Demonstration Project



STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
DISTRICT 6 - FRESNO

San Joaquin Valley Growth Response Study, Phase III
Fresno - Clovis Southeast Madera Region
Demonstration Project




Prepared for:

Department of Transportation - District 6
1352 West Olive Avenue
Fresno, CA 93728
Contact: Paul-Albert Marquez
Phone: (559)445-5867
Email: Paul-Albert Marquez@dot.ca.gov

Prepared by:

VRPA Technologies, Inc.
4630 W. Jennifer, Suite 105
Fresno, CA 93722
Contact: Georgiena M. Vivian
Phone: (559)271-1200
Email: gvivian@vrpatechnologies.com

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TABLE OF CONTENTS

SECTION **PAGE**

FIGURES

TABLES

San Joaquin Valley Growth Response Study, Phase III
Fresno- Clovis-Southeast Madera Region
Demonstration Project

EXECUTIVE SUMMARY

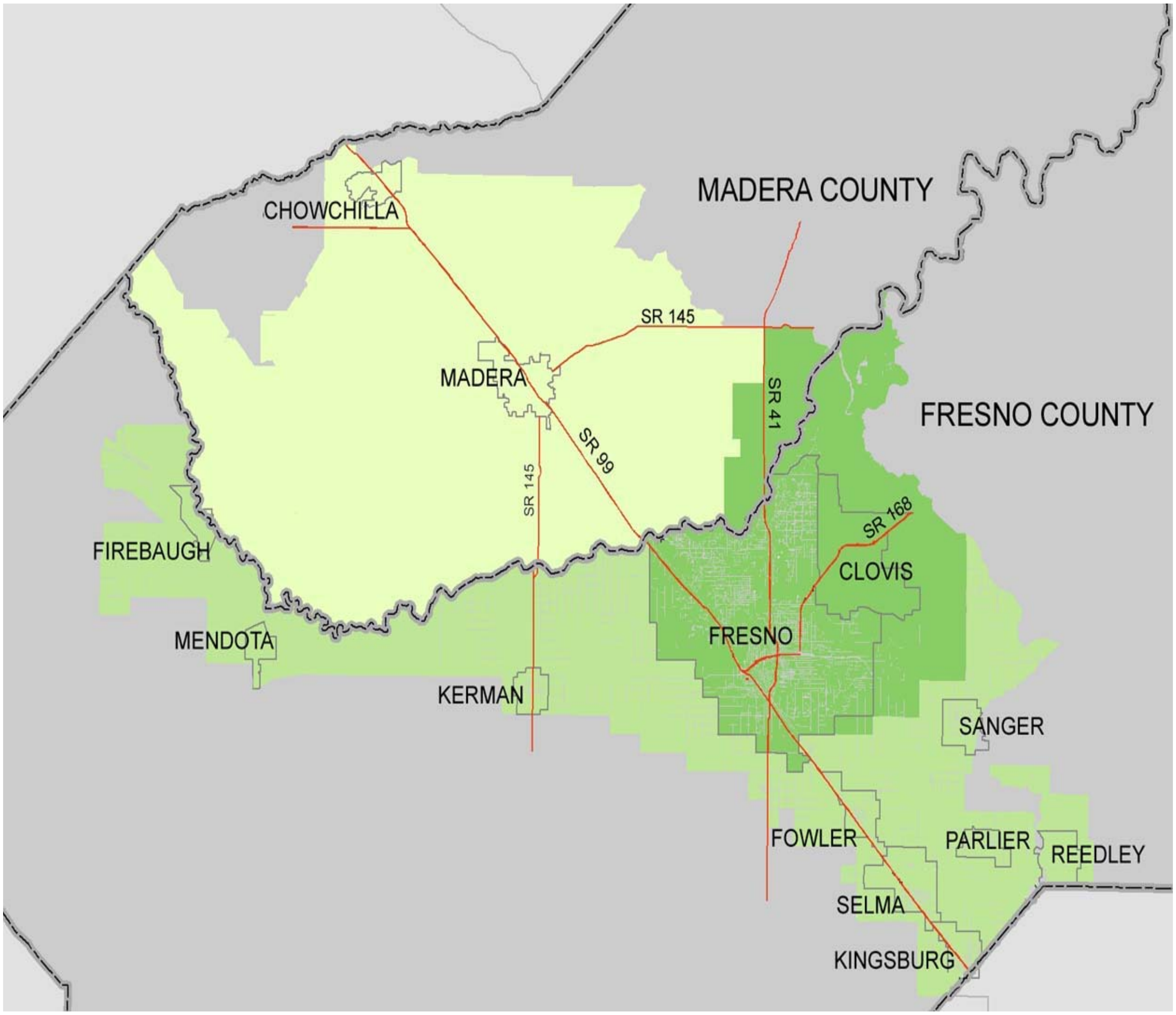
This Executive Summary provides an overview of the remaining chapters of Phase III of the San Joaquin Valley Growth Response Study (GRS), which is focused on the development of land use and transportation modeling tools for the Fresno-Madera Region or Study Area (reference Figure ES-1). The Study Area boundary was determined based upon the perceived market area for growth and development within the two counties and the availability of Geographic Information System (GIS) data.

State, regional and local agencies in the Fresno and Madera County Study Area have heard much over the years about the need to consider transportation, land use, the economy and the environment when planning for the future. The linkage between these interrelated subjects has continually been emphasized. To address this linkage, a number of new planning concepts have emerged focusing on smart growth, livable communities and sustainable growth and development. There have been a number of conferences and workshops where these concepts and practices have been discussed. Caltrans has provided the opportunity to put the concepts into action – especially given the Study Area's unique situation in the San Joaquin Valley (Valley) for the following reasons:

- The Study Area's population is going to expand significantly;
- Transportation systems in the Study Area will need to respond to that growth;
- The Study Area cannot continue to build and expand the transportation system to relieve congestion given funding issues and right-of-way constraints;
- The unique Valley environment must be protected while allowing growth and development to occur; and
- The economy depends upon the extent to which each of these outcomes can be accommodated collectively vs independently.

There have been a number of lessons learned during this Phase III demonstration project. With any quality study, there is generally a need for further investigations to clarify or expand on the findings and recommendations made in the body of work.

FIGURE ES-1
PHASE III STUDY AREA



It was found that local and regional jurisdictions need to further study certain aspects of the modeling evaluation, including but not limited to the following:

- The feasibility of the Mid-High Rise Corridor according to the development community. (It may be worth investigating if there should be less mixed use and more housing in the corridor).
- The feasibility of intensification areas and corridors identified in the study need further scrutiny.
- The feasibility of preserving corridors across the San Joaquin River for inter-county travel between Fresno and Madera.
- The feasibility of infrastructure expansion to accommodate planned development, particularly in Southeast Madera County.
- The need for Madera County to further define land uses in the new town development areas north of the San Joaquin River.

Study Purpose

The purpose of the GRS was to:

- To explore smart growth best practices and "new regionalism" opportunities
- Develop a comprehensive approach to guide growth and development within the San Joaquin Valley
- To develop the "toolbox" of land use and other models to enhance our regional planning efforts – *transportation models cannot provide all the answers*

Study Goals

The primary goals of the Study were to:

- Define the concepts of sustainable communities, livable communities and smart growth.

- Provide a baseline of information for the California Department of Transportation (Caltrans), regional, and local agencies to use in developing appropriate transportation policies and programs.

- Identify barriers for local, regional, and State agencies in responding to growth.

- Evaluate and identify appropriate tools to be used by State, regional and local agencies to determine appropriate land use, transportation, and environmental policies and plans.

Phase III Goals

The specific goals of Phase III of the Study were to:

- Create a toolbox for a large and small region within the Valley that would allow decision makers to make more informed land use decisions and to analyze potential future land use scenarios considering the linkage between land use, transportation, and the environment.

- Integrate land use, transportation, environmental, and market conditions

- Identify the potential benefits of Smart Growth concepts in terms of:
  - Costs
  - Reduced trips
  - Increased transit usage
  - Reduced air emissions
  - Increased walkability

Most importantly, the goal of Phase III of the GRS was to begin a dialogue pertaining to urban development form at the regional scale and the consideration of alternative sets of policy choices and assumptions about the future, such as alternative land uses and expansion of public infrastructure. The project includes development of a land use allocation model, and a visualization and indicator model for use with the current transportation demand models. These modeling tools will assist the Cities of Fresno, Clovis, and Madera and the Counties of Fresno and Madera in reviewing the urban landscape, considering alternative growth scenarios and their economic feasibility, and making policy changes to successfully implement their planning documents. The tools will provide information on the land use patterns that could enhance transit, reduce vehicle miles traveled, identify fiscal implications of growth and development, and address air quality issues.

Phase III also included an extensive outreach effort to involve a diverse group of stakeholders (interested transit proponents, the League of Women Voters, the Sierra Club, the business and development community, the Farm Bureau, health organizations, the San Joaquin Valley Air Pollution Control District, environmental justice groups, other advocacy groups, local elected officials, affected agency staff, and other agencies) in selecting the indicators appropriate for the models. The Stakeholders also provided input on the alternative growth scenarios to run and analyze in the models.

Why Enhance the Modeling Process?

Standard Traffic Modeling Practices are not sufficient because:

- Data is structured by Traffic Analysis Zone (TAZ)
- Projections for population, household and job growth are applied in the traffic modeling process versus actual detailed land uses
- Data by TAZ provides an inconsistent relationship to the actual land use patterns
- Traffic Model results are difficult to review with the public and decision-makers

The Phase III modeling tools will enhance the standard traffic modeling process by providing:

- <u>Parcel or block</u> geography consistent with census data
- Projections for population, household and job growth that are land use specific
- Land use patterns are defined using Geographic Information Systems (GIS)
- The Phase III modeling tools are easier to review with the public and decision-makers because the maps look more real and the alternatives can be painted interactively

Most importantly, the Phase III GRS modeling tools will encourage an integrated planning approach for the following reasons:

- Land use policies adopted by the local agencies can be more directly translated into model inputs such as land use type, densities, redevelopment and in-fill areas, etc.
- More clarity can be achieved using the tools in land use policies through model input requirements
- The Phase III modeling tools require a higher-level of interaction between land use and transportation planners

Overview of the Phase III Modeling Process

Figure ES-2 provides a graphic display of the Phase III modeling process. The major components of the modeling process include the following tools or models:

- **Land Use Allocation Model – WhatIf?**
  - Used to map existing and future land use & transportation patterns
  - Defines additional assumptions and directions for growth
  - Provides comprehensive & coordinated mapping of existing and future land uses
  - Develops demographic projections

- **Indicator/Visualization Model - INDEX**
  - Determines what the effects of growth will be under alternative development plans
  - Allows scenario testing — comparisons to baseline/business-as-usual conditions
  - Is a GIS-based Analysis Tool
  - Assesses Land Use & Demographic Patterns - Sample Indicators

- **Transportation Model Enhancements to TP+**
  - Enhances the Fresno/Madera Region's existing transportation and air quality models to be more "use" specific and to test various planning policies and land use alternatives
  - TP+ is most used transportation (traffic and transit) software package in the San Joaquin Valley
  - Like all models, in its current state, it is structurally insensitive to local land use features. Therefore, there is a need to enhance the models using the 4D process (Density, Design, Diversity, and Destinations) because many factors affect travel demand that are not easily reflected in traditional four-step models, e.g., due to scale of the TAZs).

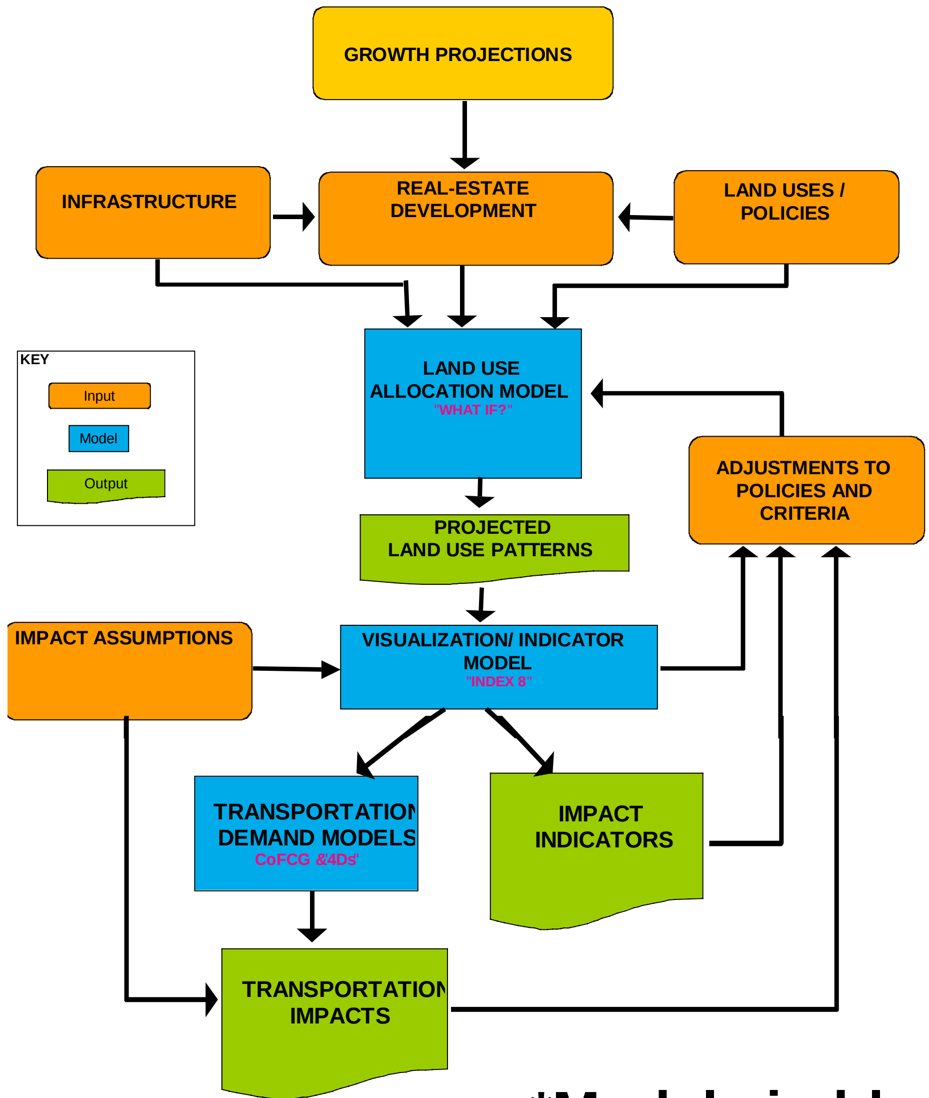
Overview of the Phase III Development Process

There were a number of steps taken by the Team to develop the GRS modeling tools. Each of these steps is highlighted below. Each step is further detailed in the following chapters of this Phase III Report.

Chapter 1- Introduction *- Describes and defines the Growth Response Study (GRS) and the need to involve stakeholders and invite them to Study Workshops over the course of the project*

Chapter 2 – Selecting the Phase III Models *– Identifies and assesses various modeling applications that may be used for purposes of the Phase III modeling process and the process applied to present findings to the stakeholders at the 1st Workshop. Figure ES-3 provides a listing of the model applications evaluated by the Study Team and highlights the models ultimately chosen.*

FIGURE ES-2
PHASE III MODELING PROCESS



***Models in blue boxes**

FIGURE ES-3
MODELS EVALUATED DURING PHASE III

Candidate Model By Model Type	1. Planning Support		2. Capability				3. Utility for COGs,			Other Key Factors for Fresno Pilot Study	Con-sultants reviewing 1-letter abbrev.
	a. Stake-holder Involv-ement	b. Regional-scale model	a. Policy testing	b. Linkag e to TP+	c. Environ-mental Impacts	d. GIS Inter-face	a. Data needs & availability	b. Resource needs & availability	c. Succes s-ful use, esp. in CA	a. Cost, and Other Acquisition Issues	
I. LAND USE ALLOCATION MODELS											
METROSIM (12)	0	2	2	2	2	2	1	0	1	$33 to 43k plus $5-10k per year maintenance (per EPA)	E,C,L
Treas. Valley* (14)	1	2	1	2	1	2	2	2	1	Min. investment in software, but time consuming process	E,C
UPLAN (15)	1	2	2	2	2	2	2	1	1	Software free, developer may need to calibrate	E,C,L
What If? (16)	1	2	2	2	2	2	2	2	1	$3k-$6k (5 sites)	E,C
PECAS (10)**	0	2	2	2	2	2	0	0	0	Expensive, could be over $200k, and additional data needs are costly	E,C,L
II. VISUALIZATION & INDICATOR REPORTING MODELS											
PLACE³S (13)	2	1	1	1	2	2	1	1+	2	Public Domain but needs support	F, Team
Web-basedPLACE³S (14+)	2	2	1+	2	2	2	1+	1+	1	$40k	F, Team
Community (12)	2	1	1	0+	2	2	2	2	0	$5k	F, Team
SmartGrowthINDEX (14)	2	1	1	2	2	2	2	1	1	Public Domain but needs support	F, Team
INDEX 8 (15)	2	2	1	2	2	2	2	1	1	$4k; includes training in OR	Team
Envision QUEST (13)	2	2	2	1	2	2	1	1	0	$150k per D. Biggs, Developer	Team

Chapter 3 – Selecting the Smart Growth Modeling Indicators *- Solicit input from the local decision-makers regarding land use, environmental, and economic indicators they would like to see studied during the Phase III modeling process. The indicators chosen by the electeds and the stakeholders are listed below.*

- *Developable land remaining after new growth*
- *Acres of agriculture remaining*
- *Development Footprint (combined measurement of infill and density of population and employment)*
- *Population density*
- *Employment density*
- *Use Mix*

- *Transit Adjacency to Housing*
- *Transit Adjacency to Employment*
- *Mode split to transit*
- *Vehicle miles traveled*
- *Vehicle hours traveled*
- *Economics of Development*
- *Air pollution (NOx, HC, CO, & CO2) emitted from light vehicles*

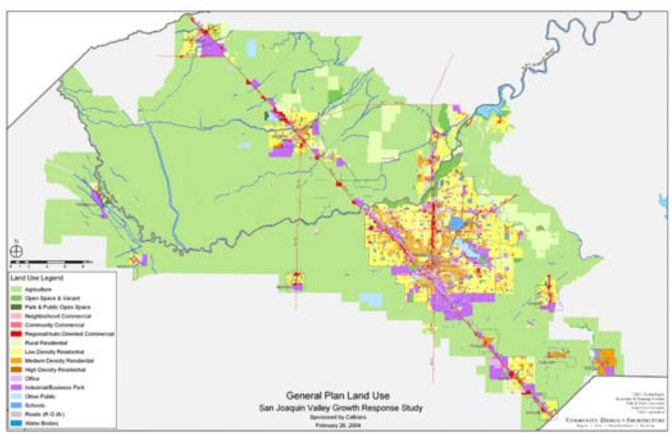
Chapter 4 – Developing the Modeling Tools *– Describes the Study Team's process to develop the existing and future (General Plan) land use data in Geographic Information System (GIS) format and the process applied to present the findings to the stakeholders at the 2nd Workshop.*

Chapter 5 – Preparing the Initial Run Scenario *– Details using the preferred set of modeling tools, analyze the Existing (2003) and future year General Plan or Initial Run scenarios, identifies alternative future year land use and transportation system scenarios and describes the process to present the findings at the 3rd Workshop. Figure ES-4 highlights results of preparing the Initial Run (General Plan) Scenario.*

FIGURE ES-4
INITIAL RUN SCENARIO RESULTS

- Initial Run City of Fresno "Build-out"

Time Period	Households	Jobs
2003	179,500	237,400
2025 Total Increment	282,400 +102,900 (37%)	399,800 +162,500 (69%)
"Build-out" Total Increment (2034)	311,900 +29,500 (10%)	496,900 +97,100 (20%)

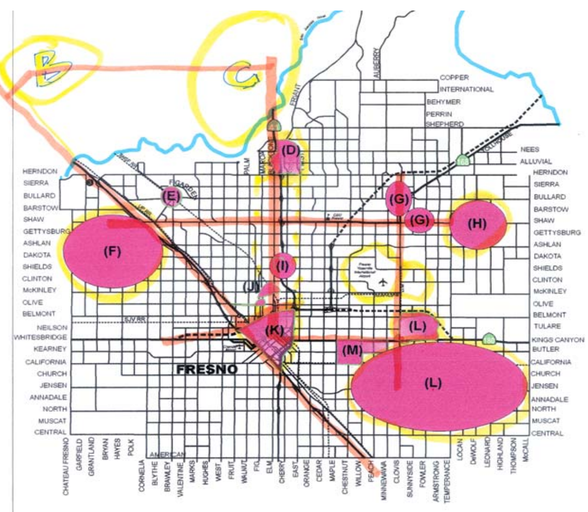


- <u>25,600 additional homes needed</u> to provide workers for all new jobs in Fresno; these are added to surrounding areas

Chapter 6 – Developing the Alternative Scenarios *– Describes using the preferred set of modeling tools, how they were applied to analyze the alternative land use and transportation scenarios, describes how the Study Team compared the indicator results to the existing condition and the Initial Run, and describes presentation of the findings to the stakeholders at the 4th and final Workshop. Figures ES-5 through 7 provide an overview of the process leading to and selecting the Alternative Scenarios. Figures ES-8 through 16 and Table ES-1 provide a summary of the various modeling results for each alternative scenario considering a few selected indicators referenced earlier.*

FIGURE ES-5
ALTERNATIVES TO THE INITIAL RUN SCENARIO

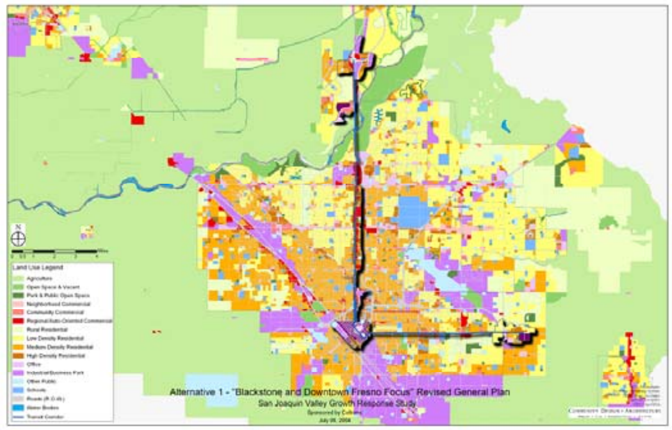
- Alternatives to the Initial Run
  - Based on Workshop #3 Polling Results
  - Preferred Network and Intensification Areas:
    - Blackstone Corridor
    - Downtown Fresno
    - Kings Canyon corridor to SE Fresno
    - SE Madera New Towns
    - Clovis Jensen to Herndon
  - Land uses with greater densities & mix than current General Plan designations
  - Connected by high capacity/high speed transit network



Preferred Transit Network & Intensification Areas
Based on Workshop #3 Input

FIGURE ES-6
ALTERNATIVE 1 – BLACKSTONE/SR 41-DOWNTOWN FRESNO SCENARIO

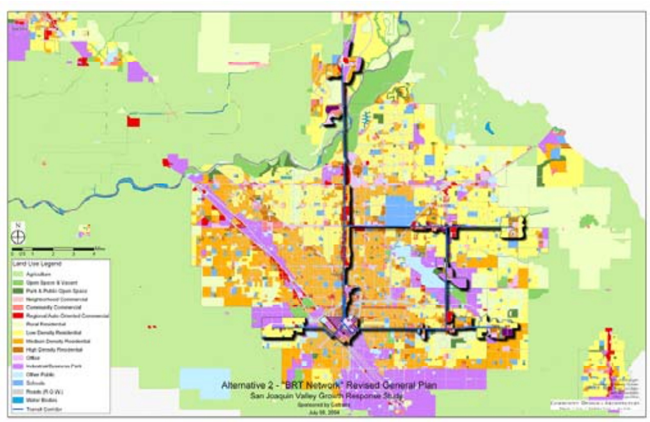
- Blackstone/41-Downtown Fresno Scenario (Alt. 1)
  - "Fixed guideway" transit routes:
    - Blackstone/41
    - Ventura/Kings Canyon
  - Intensification Areas focused on transit corridors:
    - Blackstone Corridor
    - Downtown Fresno
    - Kings Canyon corridor to Southeast Fresno
    - SE Madera New Towns



Blackstone/41 & Southeast Fresno Corridors Intensification Areas

FIGURE ES-7
ALTERNATIVE 2 – HIGH-CAPACITY TRANSIT NETWORK SCENARIO

- High-Capacity Transit Network Scenario (Alternative 2)
  - High-capacity transit mainly in dedicated lanes:
    - Blackstone/41
    - Ventura/Kings Canyon
    - Shaw - east of Blackstone
    - Clovis - Kings Canyon to Shaw
  - Intensification Areas:
    - Blackstone Corridor
    - Downtown Fresno
    - Fancher Creek & Southeast Fresno
    - Clovis Shaw Corridor & Southeast Urban Center
    - Whitesbrigde Corridor
    - Southeast Madera New Towns



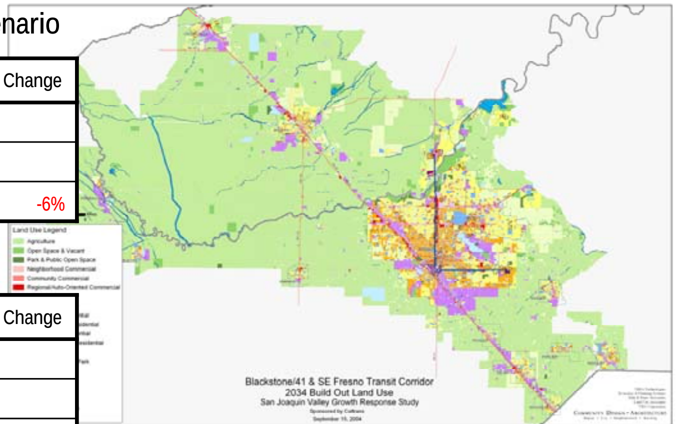
High-Capacity Transit Network and Intensification Areas

FIGURE ES-8
INITIAL RUN VS ALTERNATIVE 1 – BLACKSTONE/SR 41-DOWNTOWN FRESNO SCENARIO

- Blackstone/41-Downtown Fresno Scenario (Alt. 1) vs. Initial Run Scenario

Fresno Co.	Households	% Change	Jobs	% Change
Existing 2003	247,800		317,400	
Initial Run	450,300		678,400	
Blackstone/41	462,350	3%	639,100	-6%

Madera Co.	Households	% Change	Jobs	% Change
Existing 2003	27,100		30,700	
Initial Run	83,800		50,600	
Blackstone/41	79,400	-5%	105,550	109%



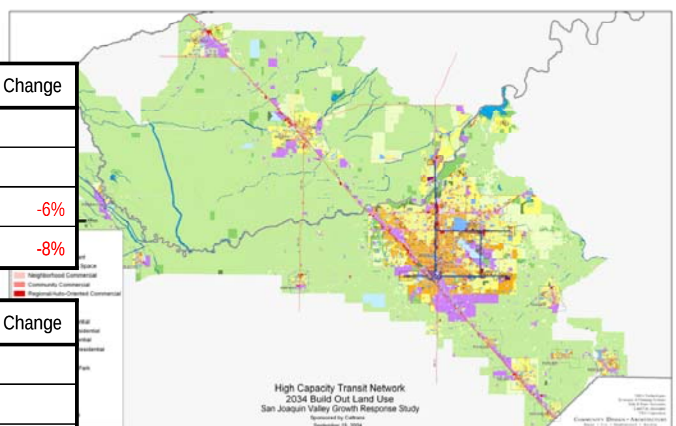
Land Use - 2034

FIGURE ES-9
INITIAL RUN VS ALTERNATIVE 2 – HIGH-CAPACITY TRANSIT NETWORK SCENARIO

- High Capacity Transit Network Scenario (Alt. 2) vs. Initial Run Scenario

Fresno Co.	Households	% Change	Jobs	% Change
Existing 2003	247,800		317,400	
Initial Run	450,300		678,400	
Blackstone/41	462,350	3%	639,100	-6%
HCT Network	440,750	-2%	622,600	-8%

Madera Co.	Households	% Change	Jobs	% Change
Existing 2003	27,100		30,700	
Initial Run	83,800		50,600	
Blackstone/41	79,400	-5%	105,550	109%
HCT Network	91,650	9%	117,120	131%



Land Use - 2034

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FIGURE ES-10
POPULATION DENSITY –
INITIAL RUN VS ALTERNATIVES 1 & 2

- Alternatives 1 and 2 vs. Initial Run

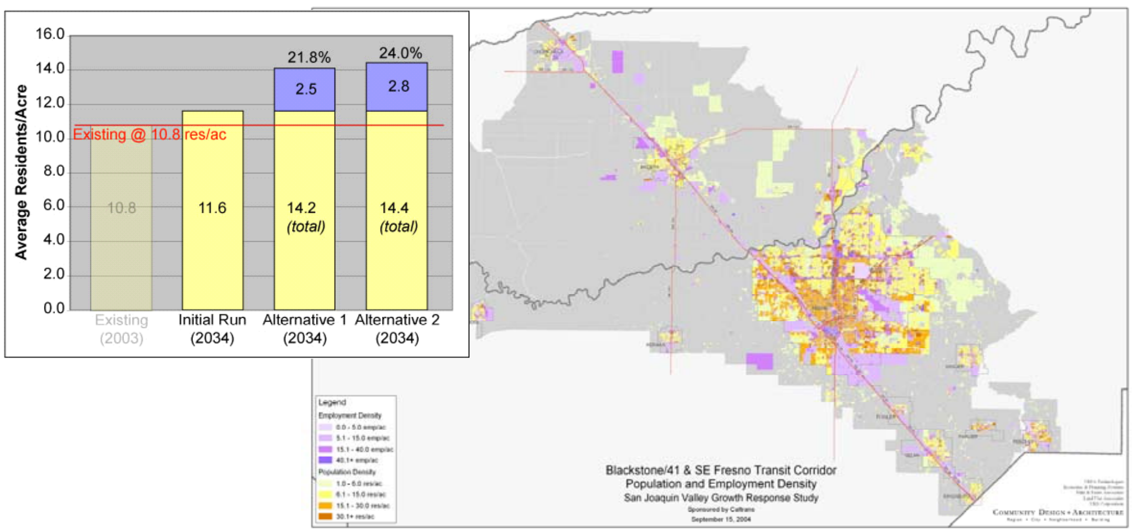

FIGURE ES-11
USE MIX –
INITIAL RUN VS ALTERNATIVES 1 & 2

- Alternatives 1 & 2 vs. Initial Run

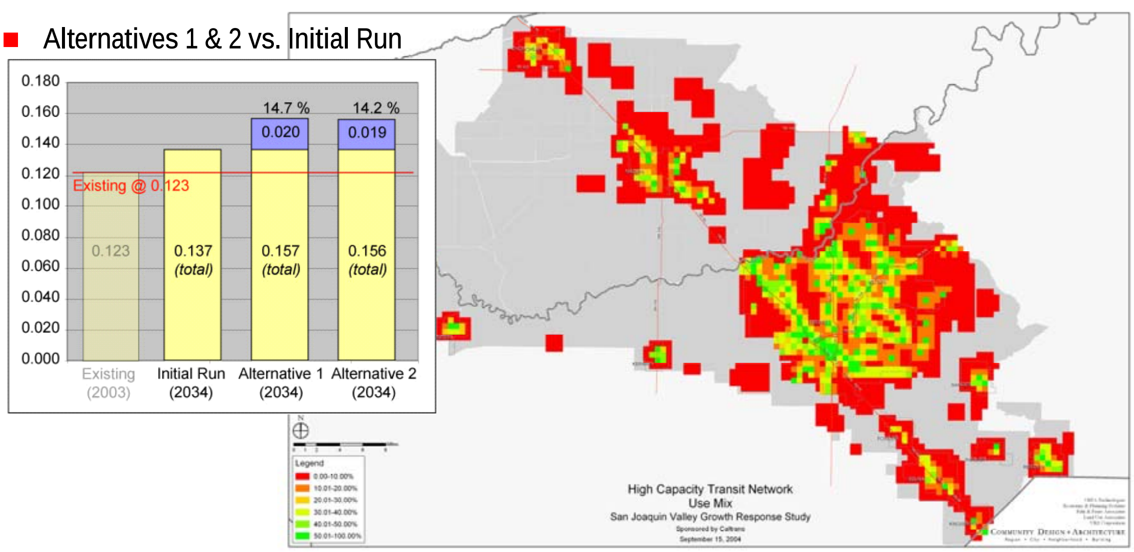

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FIGURE ES-12
DEVELOPMENT FOOTPRINT –
INITIAL RUN VS ALTERNATIVES 1 & 2

- Alternatives 1 and 2 vs. Initial Run

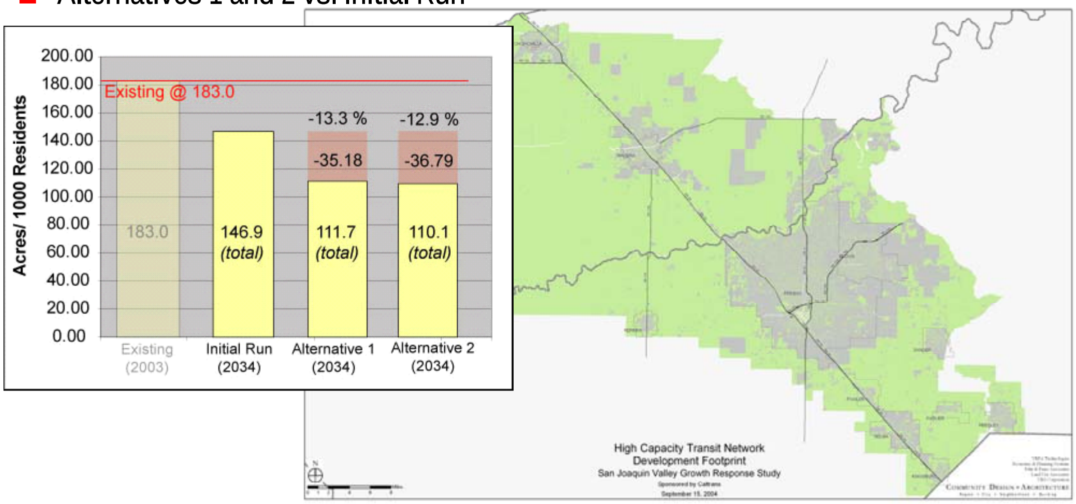


TABLE ES-1
TP+ / 4D RESULTS – INITIAL RUN VS ALTERNATIVES 1 & 2

INDICATOR:	Initial Run	Blackstone/41 (Alt 1) (vs. Initial Run)	BRT Network (Alt 2) (vs. Initial Run)
Vehicle Trips:	5,483,000	-2.0 %	-4.1 %
Vehicle miles:	45,139,000	-3.0 %	-3.6 %
Peak Auto Speeds			
--Fresno Roads:	18 mph	17 mph (-5.5%)	19 mph (+5.5%)
--Madera Roads:	28 mph	24 mph (-14.3%)	24 mph (-14.3%)
Transit Mode Split:	1.1 %	1.6% (+45 %)	1.6% (+45 %)

Summary Results:

- ***Blackstone/41 (Alternative 1) Scenario - The concentration of intensification zones in the SR 41 corridor increases opportunities to walk and use transit, but also increases vehicular traffic and congestion in this corridor.***
- ***BRT Network (Alternative 2) Scenario - Wider dispersal of intensification zones in SR 41 corridor reduces vehicular traffic and congestion in the intensification areas.***

FIGURE ES-13
TP+ / 4D RESULTS –DAILY TRANSPORTATION COSTS
INITIAL RUN VS ALTERNATIVES 1 & 2

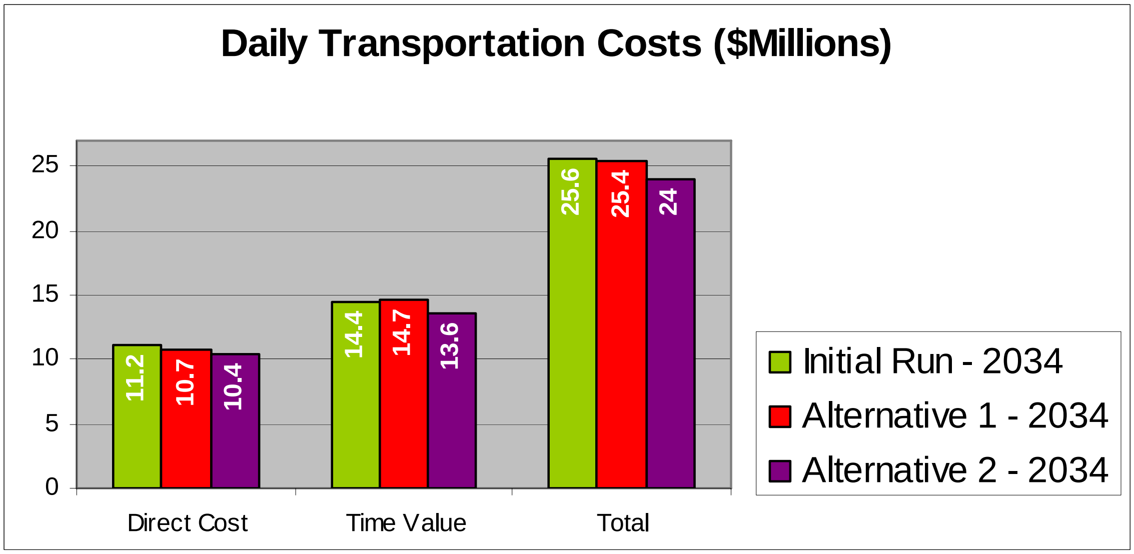


FIGURE ES-14
TP+ / 4D RESULTS –RELATIVE INFRASTRUCTURE COSTS
INITIAL RUN VS ALTERNATIVES 1 & 2

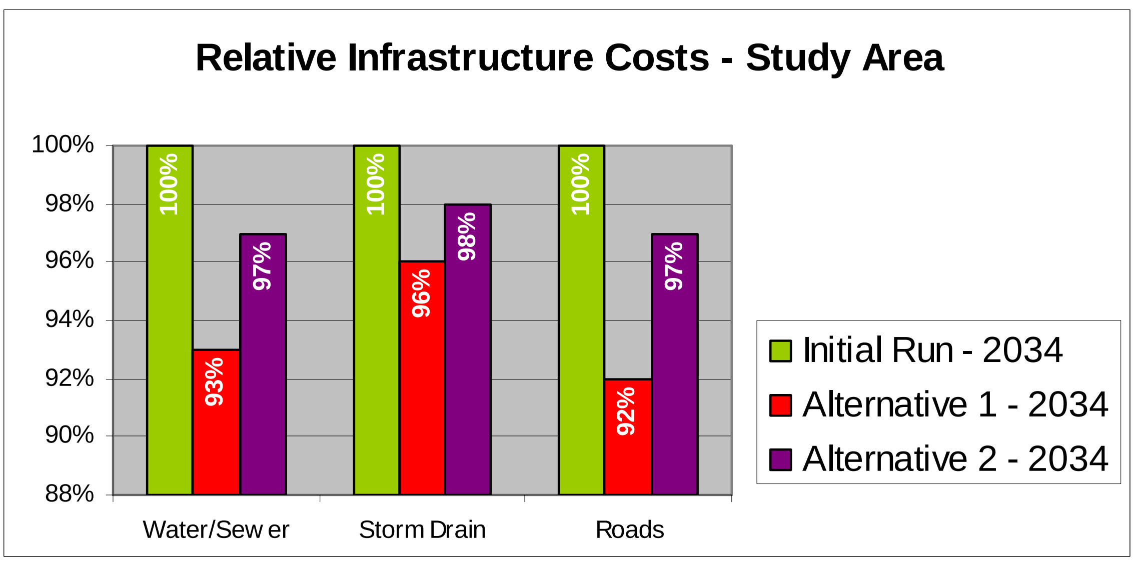


FIGURE ES-15
TP+ / 4D RESULTS –AIR QUALITY IMPACTS - ROG
INITIAL RUN VS ALTERNATIVES 1 & 2

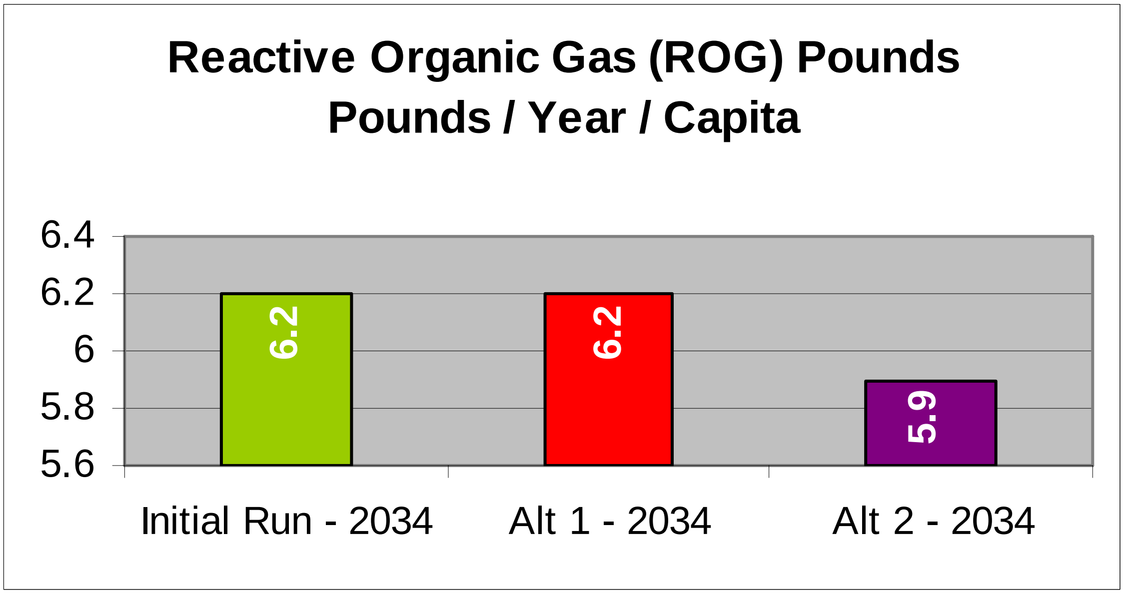
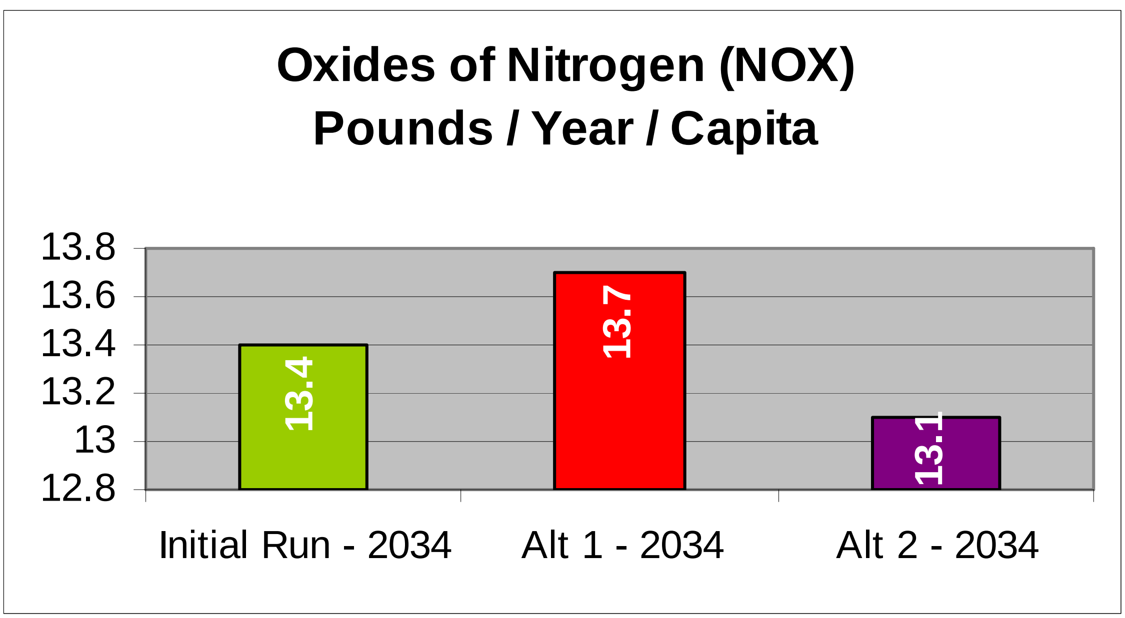


FIGURE ES-16
TP+ / 4D RESULTS –AIR QUALITY IMPACTS - NOX
INITIAL RUN VS ALTERNATIVES 1 & 2



Chapter 7 - Tool Box Issues, Recommendations, and Conclusions *– Provides a list of issues discussed during the Workshops and during presentations to the elected bodies and other groups, identifies recommendations to address the issues and findings of the Phase III Study, and provides conclusions regarding the modeling tools applied for purposes of the Phase III process.*

Chapter 8 – Tool Box Training, Presentation to the County Modeling Groups, and Next Steps *– Discusses the model training sessions already conducted during the Study, describes the need for meetings with Fresno COG and the Madera County Transportation Commission (MCTC) to review the modeling tools and present the final Study to the modeling groups in both counties, and discusses the next steps – where do we go from here?*

Chapter 9 – Presentation of the Final Phase III Study and Tool Box *– Describes the process of presenting the final set of tools and Study findings to the various City Councils and Boards of Supervisors within the Study Area.*

San Joaquin Valley Growth Response Study, Phase III
Fresno-Clovis-Southeast Madera Region
Demonstration Project

CHAPTER 1 - INTRODUCTION

This Report documents the Phase III of the San Joaquin Valley Growth Response Study (GRS), which was financed by Caltrans through a State Planning Grant and is focused on the development of land use and transportation modeling tools for the Fresno-Madera Region or Study Area (reference Figure 1-1). The Study Area boundary was determined based upon the perceived market area for growth and development within the two counties and the availability of Geographic Information System (GIS) data.

State, regional and local agencies in the Fresno and Madera County Study Area have heard much over the years about the need to consider transportation, land use, the economy and the environment when planning for the future. The linkage between these interrelated subjects has continually been emphasized. To address this linkage, a number of new planning concepts have emerged focusing on smart growth, livable communities and sustainable growth and development. There have been a number of conferences and workshops where these concepts and practices have been discussed. Caltrans has provided the opportunity to put the concepts into action – especially given the Study Area's unique situation in the San Joaquin Valley (Valley) for the following reasons:

- The Study Area's population is going to expand significantly;
- Transportation systems in the Study Area will need to respond to that growth;
- The Study Area cannot continue to build and expand the transportation system to relieve congestion given funding issues and right-of-way constraints;
- The unique Valley environment must be protected while allowing growth and development to occur; and
- The economy depends upon the extent to which each of these outcomes can be accommodated collectively vs independently.

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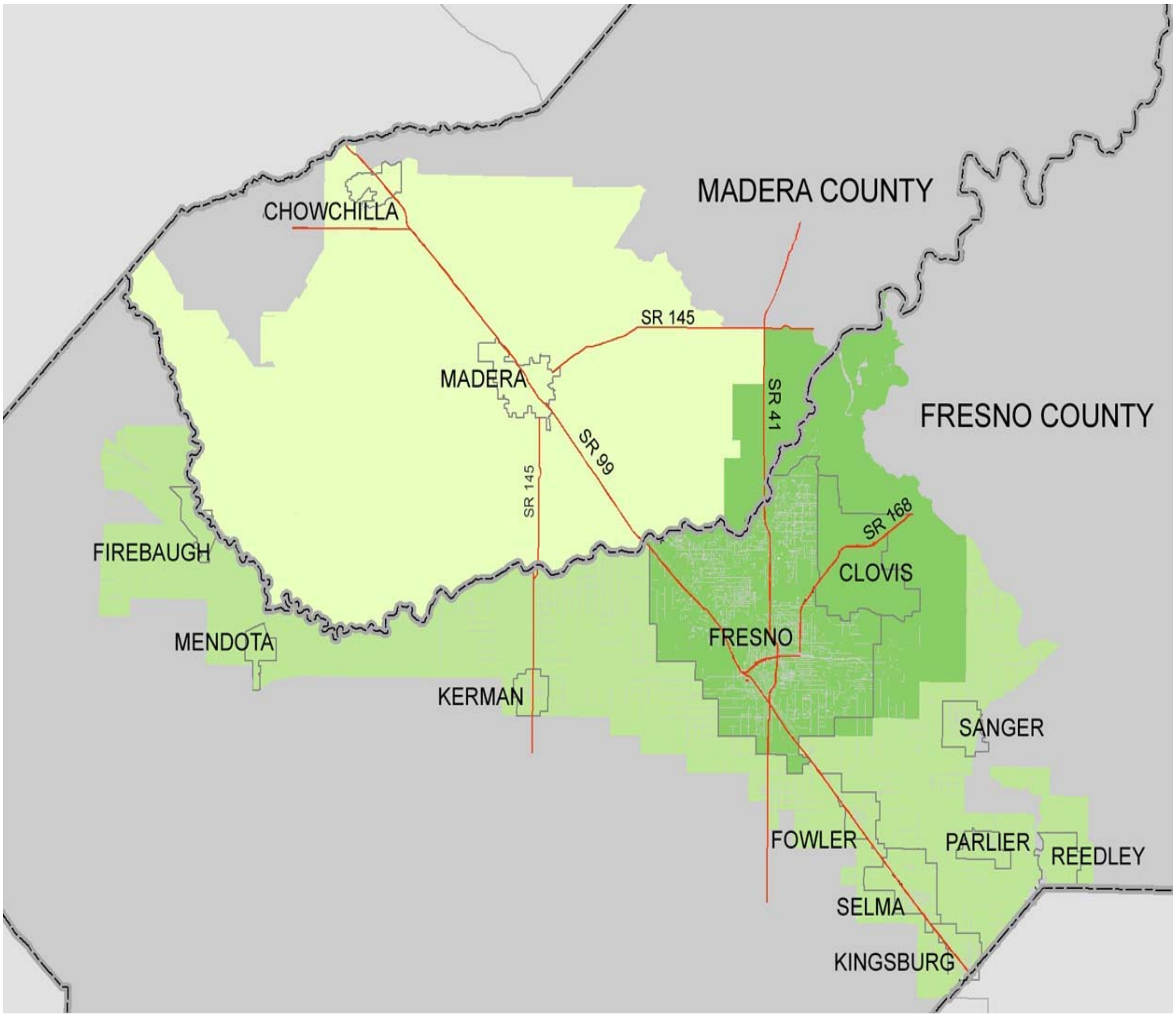
FIGURE 1-1
PHASE III STUDY AREA



Agencies in the Study Area now have the opportunity to learn and become involved in methods that will identify the benefits of growth and development while considering alternative land use, transportation and environmental scenarios. The models developed as part of the Phase III Study can identify how well land use and transportation plans can close the gap between the independent consideration of land use, transportation, the economy and the environment by quantifying the benefits of smart growth alternatives. The various tools and models developed as part of Phase III are available to help not only the planners in the Study Area determine those benefits, but also the policy makers and the public.

The Study Area has a great opportunity to do things right without the disbenefit of retrofit and catch-up philosophies through reactionary planning. The opportunity exists to learn today what our future can provide and how best to address issues before they occur. Some members of the Study Area's development community have already embraced the land use concepts and that is very encouraging. Cities such as Fresno and Clovis have recently endorsed new growth policies in their plans – and that is encouraging. Now it is time to address the barriers to these new forms of urbanism and implement smart growth concepts.

The following sections provide a general overview of the Study:

- ***What are the Goals of the Study?*** They include:

  - Define the concepts of sustainable communities, livable communities and smart growth.

  - Provide a baseline of information for the California Department of Transportation (Caltrans), regional, and local agencies to use in developing appropriate transportation policies and programs.

  - Identify barriers for local, regional, and State agencies in responding to growth.

  - Evaluate and identify appropriate tools to be used by State, regional and local agencies to determine appropriate land use, transportation, and environmental policies and plans.

  - Create a toolbox for a large and small region within the Valley that would allow decision makers to make more informed land use decisions and to analyze potential future land use scenarios considering the linkage between land use, transportation, and the environment.

- ***Why is the Study necessary?*** Significant growth is expected in the Valley over the next 25 years. In order to accommodate ***smart*** growth in the Valley, we must be able to analyze potential future land use scenarios considering the linkage between land use, transportation, and the environment.

- ***How is the Study being prepared?*** Through the development of three Study Phases:

  - Phase I – to research information related to growth, land use and transportation planning within the Valley and to develop recommendations, which could improve land use and transportation coordination. Phase I was developed by the Mineta Institute. Details regarding Phase I can be found in the Phase I Report provided at the following Internet Web address: *www.dot.ca.gov/dist6/projects.htm*.

  - Phase II – to develop an educational component that will address technical, procedural, and political barriers to integrated planning and towards overcoming these barriers. A toolbox would be developed that would help communities plan for sustainable growth and would consider the key issues of land use, transportation and economic growth and development. The tool box will address political, procedural, and technical barriers in planning with the development and utilization of strategies, including:

    - Smart growth best practices;
    - Criteria for selecting and using land use and transportation models to analyze growth;
    - A technical framework for modeling smart growth; and
    - Political stakeholders will play a key role in the success of the Study.

  Phase II was developed by the RAND Corporation. Details regarding Phase II can be found in the Phase II Report provided at the following Internet Web address *www.dot.ca.gov/dist6/projects.htm.*

  - Phase III – to evaluate urban development form at the regional scale and consider alternative sets of policy choices and assumptions about the future, such as alternative land uses and expansion of public infrastructure. The project includes development of a land use allocation model, and a visualization and indicator model for use with the current transportation demand models. These modeling tools will assist the Cities of Fresno, Clovis, and Madera and the Counties of Fresno and Madera in reviewing the urban landscape, considering alternative growth scenarios and their economic feasibility, and making policy changes to successfully implement their planning documents. The tools will provide information on the land use patterns that could enhance transit, reduce vehicle miles traveled, identify fiscal implications of growth and development, and address air quality issues.

Specifically, the land use allocation model will consider projected population and employment, future household characteristics, development densities, and other factors. Public officials and citizens will be able to view the likely impacts of alternative growth policies in easy-to-understand maps and tables. The output data would be inputted into the visualization and indicator model.

The visualization and indicator model, a GIS-based planning support system, will consider a set of indicators that local decision-makers and stakeholders could use to measure conditions, identify issues, evaluate alternative courses of action, and monitor changes overtime. Indicators could include population and employment, development density, multi-family housing share, share of employees within ¼ mile of transit, vehicle miles traveled, air pollutant emissions, etc. Output data would be further analyzed in the transportation demand models. Model outputs will be regional in nature but could be further developed for use at the community and neighborhood levels.

Phase III also included an extensive outreach effort to involve a diverse group of stakeholders (interested transit proponents, the League of Women Voters, the Sierra Club, the business and development community, the Farm Bureau, health organizations, the San Joaquin Valley Air Pollution Control District, environmental justice groups, other advocacy groups, local elected officials, affected agency staff, and other agencies) in selecting the indicators appropriate for the models. The Stakeholders also provided input on the alternative growth scenarios to run and analyze in the models.

This third phase of the San Joaquin Valley GRS was completed in October 2004. The modeling tools developed in this demonstration project can be applied by the consultant team and can help facilitate better planning for communities within the San Joaquin Valley. Subsequent reduction in vehicle miles traveled, increased transit use, or compact development would benefit the local, regional, and state transportation network.

Phase III of the Study was developed by the Study Team led by VRPA Technologies, Inc. and supported by a group of subconsultants including Community Design & Architecture (CD&A), which was responsible for developing the data sets and inputs for the WhatIf? and INDEX models, Fehr & Peers Associates, responsible for TP+ modeling and applying the 4D Process, Economic and Planning Systems (EPS), responsible for conducting the marketing study and providing advice to other Study Team members during development of the three modeling applications, and Land Use Associates (LUA) and URS Corporation, who were responsible for providing advice and research regarding local agency planning and policy development.

The Study Team also relied on advice and input from Caltrans District 6 staff. This Phase III Report can be found at the following Website www.dot.ca.gov/dist6/projects.htm.

Phase III Development Process

There were a number of steps taken by the Team to develop the GRS modeling tools. Each of these steps is highlighted below along with a brief discussion of the development process, and is further described in various chapters of this Phase III Report.

1. *Develop a list of stakeholders and invite them to Study Workshops over the course of the project.*

   A list of over 100 public and private stakeholders was compiled representing federal, State, regional and local governmental agencies and numerous non-public agencies representing the development community, health and environmental advocates, political action committees, and others. The stakeholders were invited to four (4) Workshops over the course of the 2-year Study (Workshop Announcement, Agenda, Minutes and Attendees are included shown on the Study Website at www.dot.ca.gov/dist6/projects.htm.

   In addition, the Study Team presented Phase III information and updates on the development process to various groups when requested including individual elected officials, the Fresno Area Collaborative Regional Initiative Land Use and Transportation Committee, the Environmental Justice Focus Group, and other groups concerned with the issues of land use, transportation, economic development, and environmental issues.

   The stakeholders were key in the process of selecting and developing the tools, identifying the land use, transportation, economic and environmental indicators that should be studied, discussing the alternative land use and transportation scenarios to be studied, and providing comment and input into the model development process.

2. *Identify and analyze various modeling applications that may be used for purposes of the Phase III modeling process and present findings to the stakeholders at the 1st Workshop.*

   One of the first tasks during development of Phase III was the identification and analysis of various land use allocation, indicator and transportation models or applications that have been developed or applied by various federal, state, regional, local or private agencies or firms for the purpose of analyzing smart growth concepts. Following review and analysis of the various models that could have been applied for the Phase III process, WhatIf? was chosen as the land use allocation model, INDEX was chosen as the indicator model, and the 4D Step Model was chosen to adjust various processes currently applied in the Study Area's TP+ traffic models. The 4D modeling application comprised of density, diversity, design and destination will be further explained in Chapters 2 and 4 and Appendix B. Chapter 2 provides a detailed overview of the model selection process.

3. *Solicit input from the local decision-makers regarding land use, environmental, and economic indicators they would like to see studied during the Phase III modeling process.*

   Once the models were identified, evaluated and selected for the Phase III modeling process, the next step was to identify the various indicators that were important to the various elected bodies and the stakeholders. During the months of July and August 2003, the Study Team met with the Fresno and Madera County Boards of Supervisors and the City Councils for the Fresno, Clovis, Madera and Chowchilla. The governing bodies were provided an overview of the Phase III Study and asked to identify key indicators that they would like the Study Team to focus on during development of the Phase III process. The key indicators identified by the elected officials included levels of congestion, land devoted to new development, air quality, the cost of new development, agricultural land lost to urban development, extent of increased transit ridership, and others. The results of this process were then reviewed with the stakeholders at the 2nd Workshop held on September 24, 2003. A complete listing of the final primary and secondary indicators is provided in Chapter 3 of this Report.

4. *Develop the existing and future (General Plan) land use data in Geographic Information System (GIS) format and present the findings to the stakeholders at the 2nd Workshop.*

   A significant effort was undertaken by the Study Team to develop the GIS database for purposes of this Study. The GIS database was developed for the entire Study Area, using datasets from various sources including the Cities of Fresno and Clovis, the Counties of Fresno and Madera, California State University, Fresno (CSUF), and the Merced County Association of Governments (MCAG**).** Two GIS-based computer programs were used to allocate growth projections and to perform indicator evaluations of the scenarios that were developed for the Study. Chapter 4 discusses the two models (WhatIf? and INDEX) and the data preparations that were undertaken to prepare for their use in the Study. The results of this process were presented at the 2nd Stakeholders Workshop.

5. *Using the preferred set of modeling tools, analyze the Existing (2003) and future year General Plan or Initial Run scenarios, identify alternative future year land use and transportation system scenarios and present the findings at the 3rd Workshop.*

   The next step in the process was to develop an existing land use and transportation model database for the year 2003 and datasets representing "Build-Out" or year 2034 conditions. Chapter 5 provides a detailed overview of the process. Once year 2003 and Build-Out datasets were complete, the Study Team identified numerous alternative land use and transportation scenarios that could be developed and analyzed using the set of tools. The purpose of the alternative scenarios process was to continue to show the Advisory Group (Define?) and the broader community of the Fresno and Madera County Study Area the utility of the GRS tools for future policy planning efforts in the Study Area. While the scenarios that are defined may provide a "side-benefit" to communities in the Study Area to begin testing concepts in relation to on-going planning efforts, the major focus of the GRS effort was ~~is~~ to develop these tools for the Study Area so that communities can utilize for planning activities in the Study Area. The information developed by the Team was presented at the 3rd Workshop of Stakeholders on February 26, 2004 using an interactive polling process. The results of that process were then considered by the Study Team and the final two alternative scenarios were defined.

6. *Using the preferred set of modeling tools, analyze the alternative land use and transportation scenarios, compare the indicator results to the existing condition and the Initial Run, and present the findings to the stakeholders at the 4th and final Workshop.*

   Following Workshop #3, generalized intensification areas were refined to a specific geographic boundary at the parcel level. The prioritization of the Intensification Areas resulted in a number of previously separate intensification areas being combined, due to their close proximity and/or relative importance. Grouping the intensification areas allowed many of the more minor areas to be captured in the analysis. Potential transit corridors were also identified that complemented the location of the intensification areas in order to provide a framework that would connect land use intensification with significant transit service. This framework was then refined to two Alternative Scenarios to analyze as a contrast to the Initial Run Base Alternative.

   Both Alternative 1: the Blackstone and Downtown Fresno Focus Scenario and Alternative 2: the Bus Rapid Transit (BRT) Network Scenario drafts and their order of magnitude growth projections were then reviewed with the Cities of Fresno and Clovis, since the Intensification Areas were largely concentrated within these jurisdictions. Based on this feedback, the two Alternatives were finalized for the model runs.

The Alternatives were processed to determine the amount and type of land use capacity within the intensification areas, and then the amount and type of growth that the intensification areas would absorb. Members of the Study Team developed detailed land capacity tables at the parcel level in order to determine the amount and type of growth that would be located within the Intensification Areas based on market demand and preferences for these pedestrian-friendly and more transit-focused areas. With the 4-D Model, density, diversity, design and destination were considered in this process. A detailed review of this process is provided in Chapter 6.

In addition to the workshops identified above, the Study Team provided a number of presentations to various interested groups (Leadership Fresno, Environmental Justice Group, Transportation and Land Use Committee of the Fresno Business Council, Caltrans System of Transportation Planning in Sacramento, and others) regarding the Phase III Study and the Tool Box.

7. *Tool Box Issues, Recommendations, and Conclusions*

During development of the Phase III Study, there were several obstacles to overcome. These problems were related to the state of the GIS data acquired for both Fresno and Madera Counties, the lack of correspondence between data acquired from the various planning authorities, and the function and interface of the models. Depending on the scale at which future planning exercises will require~~d~~ use of these models, some of these issues will be more of a concern than others. However, if efforts are made to provide a comprehensive, standardized, and detailed GIS data set, the majority of issues encountered would be minimized or resolved, and the power of these models could be more fully realized resulting in a more streamlined process. Chapter 7 describes the main issues that will need to be addressed and outlines an approach to resolving the issues.

8. *Conduct a training session with Fresno COG and Madera County Transportation Commission (MCTC) staff to review the modeling tools, and present the final Study to the modeling groups in both counties and discuss the next steps.*

Chapter 8 provides an overview of the Tool Box training provided to staff of Fresno COG and MCTC, as well as other interested agencies in June and November 2004. In addition, members of the Study Team, in consultation and coordination with Fresno COG, presented the final Phase III Study Tools to the Fresno COG Model Steering Committee in May 2005. That presentation focused on the benefits of the tools, the short- and long-term application of the tools, and Fresno COG, local agency, and other staff resources needed to apply the tools. MCTC has requested a similar presentation at its upcoming June 2005 Technical Advisory Committee meeting (Update text when completed).

9. *Present the final set of tools and Study findings to the various City Councils and Boards of Supervisors within the Study Area.*

   Study Team Staff the Final Phase III Study process and Tool Box to the Counties of Fresno and Madera (May 2005) and to the City Councils of the Cities of Fresno (June 2005) and Madera (May 2005). As of the date of this Report, all the presentations were complete except to the Clovis City Council. Further detail regarding the Team's presentations is provided in Chapter 9 of this Report.

10, *Complete and publish the Final Phase III Study Report.*

   This Report completes the contract requirements of the Phase III Study process. This Final Study was published on June 24, 2005.

CHAPTER 2 – SELECTING THE PHASE III MODELS

The Phase III Study involves development of a planning and scenario-testing process that results in a series of models for regional and local governments' use in the Fresno and Madera County Study Area. To initiate development of the Phase III Study, a suite of land use and transportation models were identified. Specifically, the Phase III planning process utilizes a set of three (3) distinct models:

- The first model, the land use allocation model, predicts future growth patterns based on current trends and policies to the year 2034. This trend-line projection of future growth is called the Initial Run Scenario.

- The second model, the indicator and visualization model, analyzes and presents in a visual manner, the impacts of both the Initial Run Scenario and two (2) alternative scenarios that also accommodate 2034 growth, producing indicators and graphics that allow for ready comparison of the Initial Run to alternative scenarios.

- The final model is the transportation model enhancement model that translates the Initial Run and alternative scenarios into travel demand compatible with the Council of Fresno County Governments (Fresno COG) and Madera County Transportation Commission (MCTC) four-step travel demand models, which are the models used to devise official estimates of travel demand and impacts for transportation funding and air quality planning purposes.

This Chapter describes the selection process used for the three types of models that have been employed in support of the planning process, and describes how the finalist models in each category operate.

Refinement of the Model Short List

Phase II of the SJVGRS produced a short-list for each of the first two model "types" as shown in Table 2-1.

TABLE 2-1
PHASE II RECOMMENDED SHORT LIST OF MODELS

I. Land Use Allocation Models	II. Visualization/Indicator Models
MEPLAN METROSIM	Community Viz PLACE^{3}S SmartGrowth INDEX UPLAN WhatIf?

This short-list from Phase II was used as the starting point for the Phase III Study Team's final screening and evaluation. The list of candidate models was modified slightly to account for recent developments with respect to particular modeling tools, and the Phase III team's reassessment of model capabilities and strengths.

For example, PECAS replaced MEPLAN on Type I list, since PECAS is supplanting MEPLAN in the Sacramento Region, and no other comparable recent applications of MEPLAN were identified. Two models (UPLAN and WhatIf?) were shifted from Type II to Type I since further analysis revealed that their strengths were in land use allocation. The Treasure Valley Model, considered, but not short-listed in Phase II, was revived since many members of the Phase III were familiar with it. Preliminary interviews with its developers led to consideration of a new Type II model (Envision QUEST), which had received good reviews in several international applications. Also added was the parent model of SmartGrowth INDEX (INDEX, who's most recent version is INDEX 8) since this model appeared to have some advantages over SmartGrowth INDEX, and a newly developed web-based application of the PLACE^{3}S model.

Based upon the above findings, the final list of models evaluated by the Phase III Study Team is as shown in Table 2-2:

TABLE 2-2
PHASE III SHORT LIST OF MODELS

I. Land Use Allocation Models	II. Visualization/Indicator Models
METROSIM	Community Viz
Treasure Valley	PLACE^{3}S
PECAS	Web-based PLACE^{3}S
UPLAN	SmartGrowth INDEX
WhatIf?	INDEX
	Envision QUEST

Model Evaluation Criteria

The evaluation criteria used by the Phase III Study Team was essentially the same as that used by the Phase II Study Team. The evaluation process was enhanced to include a numeric scoring system (0 to 2, where 0 = not at all, 1 = somewhat, and 2 = definitely affirmative) applied to each of the criteria based on answers to the following questions:

♦ At which stage of the <u>planning process</u> does the model function?

  ➢ Can the output of the model be simply represented and explained in public hearings, citizen group meetings, and other forums of participatory planning? Is the model transparent enough to be explained in simple terms to the lay public?
  ➢ Is the model sufficiently linkable to other models it must link to?

♦ What are the model's <u>capabilities</u>? More specifically:

  ➢ Can the model accommodate, test, predict, and evaluate smart growth design and policy options? For Type 1, how does the model perform land use allocation in response to policy variables?

  ➢ Can the model interface with the TP+ model, or otherwise enhance conventional 4-step transportation models (e.g. Fresno COG model) by capturing effects on mode selection, vehicle trips, VMT of several variables (socio-economic, urban design variables, quality descriptors of transit, bike and walk modes)?

  ➢ Does it predict a range of environmental consequences (beyond transportation outcomes), including agricultural land consumption (essential) and emissions?

  ➢ Does the model have interactive potential (e.g., for use in a workshop or other quick-turnaround situations)? Does it have a visual outputs and GIS interfaces?

- What is the model's practical utility? Specifically:

  - Does the model have reasonable data requirements? For example, are model requirements for GIS shape-files for land use, socio-economic variables, policy boundaries (urban services, agricultural-land classes, growth boundaries), and environmental constraints, etc. within the grasp of Fresno County planning agencies?

  - Is it likely that there are sufficient resources available in Phase III to use the model effectively?

    - To what extent does the model match staffing and budget resources typical in the Fresno County Study Area?
    - To what extent do models require continual re-calibration or inputs that rely regularly on expertise in specialty areas (e.g., real-estate market economics) that would place an unacceptable burden on agencies using the model?

  - Does the model have a history of successful use in suburban/rural high-growth areas, including such areas of California? Does the model have favorable reports from users?

The Phase III Study Team evaluation consisted of reviews of model documentation and demonstrations, and interviews with specific model developers and users. The evaluation also included consideration of two (2) other key factors: cost and other model acquisition issues.

The evaluation criteria and scoring system was used to develop a matrix (reference Tables 2-3 and 2-4). Table 2-3 show scores for all of the considered models against all of the above criteria and identifies the highest ranked and runner-up model in each category. Table 2-4 summarizes qualitative aspects of the models evaluated. Finally, a flow chart that illustrates key data needs and transfers from one model to the next is included as Figure 2-1.

TABLE 2-3
PHASE III MODEL SELECTION EVALUATION

Candidate Model By Model Type	1. Planning Support		2. Capability				3. Utility for COGs,			Other Key Factors for Fresno Pilot Study
	a. Stake-holder Involve-ment	b. Region al-scale model	a. Policy testing	b. Linkage to TP+	c. Environ-mental impacts	d. GIS inter-face	a. Data needs & availability	b. Resource needs & availability	c. Success-ful use, esp. in CA	a. Cost, and Other Acquisition Issues
I. LAND USE ALLOCATION MODELS										
METROSIM (12)	0	2	2	2	2	2	1	0	1	$33 to 43k plus $5-10k per year maintenance (per EPA)
Treas. Valley* (14)	1	2	1	2	1	2	2	2	1	Min. investment in software, but time consuming process
UPLAN (15)	1	2	2	2	2	2	2	1	1	Software free, developer may need to calibrate
What If? (16)	1	2	2	2	2	2	2	2	1	$3k-$6k (5 sites)
PECAS (10)**	0	2	2	2	2	2	0	0	0	Expensive, could be over $200k, and additional data needs are costly
II. VISUALIZATION & INDICATOR REPORTING MODELS										
PLACE³S (13)	2	1	1	1	2	2	1	1+	2	Public Domain but needs support
***Web-based PLACE³S* (14+)**	2	2	1+	2	2	2	1+	1+	1	$40k
CommunityViz(12)	2	1	1	0+	2	2	2	2	0	$5k
SmartGrowthINDEX (14)	2	1	1	2	2	2	2	1	1	Public Domain but needs support
INDEX 8 (15)	2	2	1	2	2	2	2	1	1	$4k; includes training in OR
***Envision QUEST* (13)**	2	2	2	1	2	2	1	1	0	$150k per D. Biggs, Developer

Key to Numerical Evaluation. 0 = no 1 = somewhat; 2 = definitely

TABLE 2-4
MODELING SCREENING – QUALITATIVE ASPECTS AND CONTACTS

Candidate Model By Model Type	Comments on Models	Sources of Information (Suppliers and USERS)
I. LAND USE ALLOCATION MODELS		
MEPLAN	SACOG has used MEPLAN, but is moving toward PECAS.	SACOG
METROSIM	METROSIM is an early microsimulation model, based on the economic choices of households/ individuals. It has been superseded by more recent microsimulation models; see PECAS. Primary uses in New York and Chicago regions. **Fatal Flaw**: Data and calibration requirements create high cost and long set-up time.	Alex Anas & Associates, / New York Region and Chicago
TreasureValley	Treasure Valley is a rules-based model, where land uses are allocated based on existing land use clusters (gravity/Lowry model), vacant land development opportunities, and a measure of transportation accessibility. The relative weighting of the three factors was based on a regression analysis of historical data. The model has been used to generate baseline growth projections. It is a spreadsheet model built, with an open architecture and no built-in assumptions. Running alternative scenarios is less automated than with other models, and the model is untested with respect to testing different policy scenarios.	Reid Ewing, Spatial Dynamics, Fehr and Peers, Strategic Economics, CD+A / Boise, Idaho
UPLAN	UPLAN is a rules-based model, where land uses are allocated based on inputs concerning permitted development by subarea and the weighting of each subarea based on transportation accessibility; some additional allocation criteria can be added. The basic model does not incorporate any economic factors. A demonstration of the model was provided by the model developer. This model is a potential candidate for SJV Phase III when operated in concert with economic/land use side analyses. The model interface (i.e. the series of windows for entering data and setting key assumptions) and the need for AVENUE/Visual Basic programmer involvement are the software's main drawbacks.	Prof. Robert Johnston, UC-Davis, D. Shabazian (SACOG)
What If?	What If? is a rules-based model, similar in many ways to UPLAN with a more transparent structure and easier-to-use interface. Current version is limited to 18 land use categories and 10 suitability criteria, but this will increase to 80 and 20, respectively, with new version due end of August 2003. The basic model does not incorporate any economic factors. Software was downloaded from Model Developer Website and tested. Model developer was interviewed. Website is illustrative of the user-focused demeanor of this software developer. This model is a strong candidate for SJV Phase III when operated in concert with economic/land use side analyses.	http://what-if-pss.com R. Klosterman, Hudson, OH / several other communities in OH; no CA users.

TABLE 2-4 (Continued)
MODELING SCREENING – QUALITATIVE ASPECTS AND CONTACTS

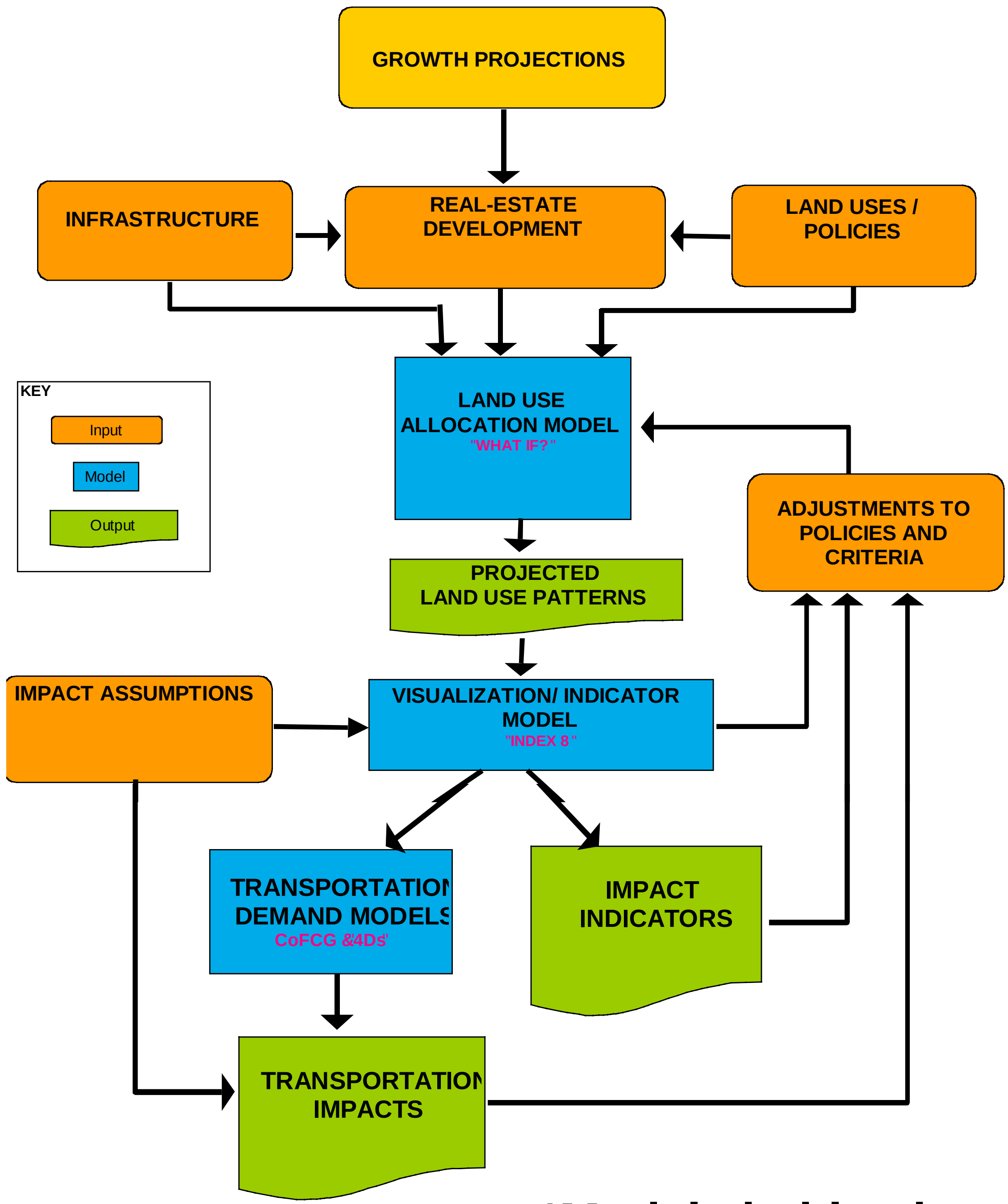
Candidate Model By Model Type	Comments on Models	Sources of Information (Suppliers and USERS)
PECAS	PECAS marries microsimulation and Lowry-type (gravity) spatial interaction components. It is based on utility functions that define the economic choices of all actors, households and businesses. SACOG is moving toward PECAS. PECAS is a new model that has not been fully applied anywhere. **Fatal Flaw**: Data and calibration requirements create high cost and long set-up time.	John Hunt / SACOG and SCAG
II. VISUALIZATION & INDICATOR REPORTING MODELS		
PLACE3S - desktop	Desktop version appears labor, time and expertise intensive; good base of experience in CA. Built upon and dependent upon ArcView 3.2 and Avenue programming (no longer state of the art in GIS)	CA Energy Commission SACOG, SLOCOG, Michael Clay, UC-Davis
PLACE3S Web-based	Uses data base software and web linkage to eliminate need for GIS-based calculations: GIS software not needed to display results. Can recalculate all indicators for 250,000 parcels in minutes. Built-in indicators comparable in scope to desktop; many more can be programmed. Requires Eco-Interactive support and participation. Additional program likely to be needed to develop a full array of indicators. Per Eco-Interactive and Fehr and Peers Roseville Office, additional indicators Only implementation in CA is for SACOG; here it performs primarily transportation calculations using a fixed network assumption. It does not show side-by-side comparisons of baseline land use relative to "scenarios"; produces maps, but not bar charts or other user-friendly indicator graphics. Additional programming subsidization from Energy Commission or Caltrans HQ may be possible, which would increase the attractiveness of this package; several other regions are seeking this subsidy.	Ann Happel, Eco-Interactive Nancy Hanson, CA Energy Commission: Mike McKeever, Dave Shabazian, SACOG
CommunityViz	Developer contacted; no default formula for indicators, entirely user-specified; works with ArcView/ArcGIS; little application in CA or for regional scale analysis. Developer is interested in CA and rural issues; can do web-based demo. Works with WhatIf? model.	www.communityviz.com Marcy Allen, CommunityViz Ken Snyder, Placematters.com
Smart Growth INDEX (SGI) US EPA	Documentation collected; has 56 built-in indicators, plus potential for more. New Version 2.0 to be used in 14 communities beginning in mid-2003, including Merced region (MCAG lead agency). Land Use allocation and "4D" components now obsolete (now a Type II model). Works with WhatIf? model Most successful applications are Charleston SC and Wilmington DE. MCAG is not among "partners" according to Elliot Allen.	US EPA www.epa.gov/smartgrowth Charleston SC, Indianapolis Eliot Allen, Eric Main Criterion:

TABLE 2-4 (Continued)
MODELING SCREENING – QUALITATIVE ASPECTS AND CONTACTS

INDEX 8	Per Ken Snyder, placematters.com, INDEX has longest track record, and would be best choice if time constraints are primary consideration. Training and participation by Criterion is available. Produces similar indicators as SGI. Does over-the-network accessibility measurement. Based on ARCGIS (ArcVIEW successor). Cost: $3900. Real time "paint the town" capabilities from pallet of land use types and facility types. Houston study compared with PLACES and preferred INDEX.	Eliot Allen, Eric Main, Criterion: www.crit.com/ Sacramento Air Quality Collaborative; Ken Snyder, Placematters.com
Envision QUEST	User-friendly in demo; more regional in scope than CommunityViz; not deployed in CA, though eager to work in CA and SCAG may use. Very good research databases behind its models. Expensive; $150k	www.envisiontools.com/ Dave Biggs; J. Fregonese
III. COFCG & MCTC TRANSPORTATION MODELS (TP+) INTERFACE AND 4D'S POST PROCESSOR		
4D Post-Process - refines Transit & NM demand estimates	Fehr and Peers has developed a number of spreadsheet based models that utilize 4-step model inputs and outputs to create more refined estimates of transit and non-motorized travel based on local & national data of how travelers respond to Density, Diversity (mixed LU) Design, & Destination proximity. See memo text and flow charts for more information on how the 4Ds model works with the other models to be used in this study.	Sacramento AQ Collaborative, SACOG, MN Met Council
Transit Demand and Mode Choice models	COFCG TP+ Traffic Forecasting Model and Mode Choice Model MCTC TP+ Traffic Forecasting Model (covers three Counties – Madera, Fresno, and Merced)	Mike Bitner, Sharri Ehlert, Mike Aronson, Derek Winning

Key Abbreviations:
SACOG = Sacramento Area Council of Governments; SCAG = Southern California Association of Governments; SLOCOG = San Luis Obispo Council of Governments

FIGURE 2-1
RECOMMENDED PHASE III MODELING PROCESS



***Models in blue boxes**

The next two sections of this Chapter document the selection process for the Land Use Allocation and Visualization and Indicator Models that were used in the Phase III Study process, and describes the selected models and their operating requirements. The final section discusses how the output of these models were integrated with the Fresno COG regional four-step travel demand model, as well as certain off-model refinements to that travel demand model that enabled better understanding of the effect of fine-scale land use and urban design alternatives. It was anticipated in Phase II that such refinements could be accomplished within one of the Type I or Type II models, but the Phase III Study Team found that there was not an existing model capable of independently producing these refinements.

Land Use Allocation Model Evaluation Process

Land Use Model Selection Process

The Study Team thoroughly evaluated several land use allocation models. Two broad categories of models were evaluated – rules-based and economic simulation models. Rules-based models are simpler to use, less costly to purchase, and have more basic and fundamental data requirements. In comparison, economic simulation models are more sophisticated and robust, but also cost significantly more, and have much more comprehensive and detailed data requirements. For the purposes of this Study, a rules-based model is more appropriate, due to available funds, and constraints in time and data. A rules-based model, though simpler, was expected to be fully sufficient for the needs of this Study. Use of a more complex economic model, even if feasible, would not guarantee more accurate land use forecasting.

Two rules-based models were evaluated for final selection, “What If?” and “UPLAN.” As shown in Tables 2-3 and 2-4, “What If” is a more appropriate choice given the scope and intent of the model application for the Phase III project. It is more user-friendly and transparent (e.g., assumptions made are more clearly apparent), is ready to use out of the box without requiring further customization by software programmers, is more supportive of the objectives of the Study, and the data outputs from “What If?” can readily be used for further analysis both by the visualization and indicator tool and in the travel modeling effort.

Model Scope and Data Requirements

“What If” can be used at a range of geographic scales, from local neighborhoods to communities to multi-jurisdictional regions. Its simple data requirements are comprised of GIS shape files of existing land use patterns and projections of future population and job growth. It can make use of land use plans (e.g.; existing General Plans or alternative land use plans), infrastructure plans, parcel data, and essentially any other relevant data provided in GIS format. Criteria may be defined to determine where certain land uses may or may not occur, including both urban and natural factors (e.g., proximity to transit nodes, and riparian corridors). Being a rules-based model, "What If" cannot directly accommodate principles of land use economics, but approximations are possible using several configuration options and professional judgment. Up to five (5) projection years may be modeled, with any length of time between each.

For the purposes of this Study, it was expected that the following data would be required:

- Population and Employment Growth Projections;
- Real Estate Demand Projections, based on Growth Projections;
- Existing Land Use data, at the parcel level;
- Existing Transportation and Other Infrastructure;
- Existing Land Use Plans, General and Specific Plans;
- Existing Infrastructure and Transportation Plans; and
- Natural factors data – Topography, agricultural land, riparian corridors, valuable ecological habitat, etc.

Data Processing Limitations and Timeframe

"What If" has no data processing limitations. Processing time is dependent upon geographic scope, level of detail of data, and technology available. In a study conducted for seven (7) counties in Ohio, approximately 10 minutes was required to run the model on 300,000 zones/parcels, using a computer that would now be about four years old. Actual processing time for the Phase III Study Area can only be determined once data is acquired and a test run is completed. During the process of choosing the models for the Study, it is expected that the model would not be fast enough for real-time application, but will have a turn-around time, including post-processing, of several hours per set of runs (i.e. multiple scenarios).

Potential Benefits of the What If? *Land Use Allocation Tool*

- *Clarity in Land Use Assumptions*
  - The *What If?* tool requires that a clear set of assumptions be made regarding the future capacity of specific general plan or zoning designations.

- Capacities can be calculated using more detailed geography, potential at a parcel-by-parcel basis. The assumptions that are made are clearly documented, can be replicated without much effort.

- The assumptions can be fairly easily varied to test a range of future market demand or other growth variables.

♦ *More Detailed and Clear Allocation of Future Growth*

- *What If?* allocates growth to a level of geography that is defined by the user and the availability of data. In the case of Fresno County this could be down to the parcel level.
- This level of detail allows growth alternatives to be mapped at the parcel level which is easier to understand when compared with demographic projections to TAZ geography.

- The What If? tool also gives the user the ability to clearly define and direct growth based upon market and natural factors, as well as general preferences for where growth should be allocated first.

- In addition to being more visually clear the outputs can be brought into the INDEX assessment tool for more fine grained analysis.

Type I Recommended Model – WhatIf?

Based upon the above assessment, the Study Team recommends use of the WhatIf? Land use allocation model to model the Study Area.

Visualization and Indicator Model Evaluation Process

The Study Team evaluated several Visualization and Indicator Models, which permit analysis of key types of impacts that result from development with specific characteristics (e.g., quantity, mix and intensity of land uses). Evaluation criteria were identified, as discussed above and as shown in the Model Evaluation Matrix (reference Table 2-3). Key criteria included the ability to produce the primary environmental, economic and transportation indicators, ability to work in conjunction with the candidate land use allocation and transportation models, and ability to work within the range of data and technical resources available within the Study Area.

As the matrices indicate, INDEX 8 emerges as the preferred model, with the web-based version of PLACE'S the next-highest rated model. INDEX and web-based PLACE'S had total scores within one point of one another.

The web-based PLACE'S has considerable strengths in terms of rapid processing times and potential flexibility of use. In its application in Sacramento under the auspices of the Sacramento Area Council of Governments (SACOG), maps and indicators reflected changed assumptions that were redrawn and recalculated in seconds. This is because data processing is done on a high-speed, off-site server. The web-based nature theoretically allows it to be implemented on any computer with Internet access; GIS software and high-speed central processing chips are not essential. The software is intended for real-time interactive planning in remote workshop settings, and has been successfully used in this way according to SACOG staff and consultants interviewed. This possibility for results in real time is an attractive feature, but not an essential one for this project, since it is not intended to develop and analyze development scenarios in a single session.

INDEX emerges as the first choice on the basis of its clearer data and programming needs, better documentation, and the fact that there is a unitary developer of the software; moreover, the developer of INDEX has a planning background. The costs and intricacies of acquiring web-based PLACE'S also appear to be greater than for INDEX. While the web-based PLACE'S software is available for free from the California Energy Commission, it would be necessary to engage the services of a specialized database consultant (EcoInteractive) to upload and maintain data for the Study Area, and also to implement new indicators not currently in use. The California Energy Commission has indicated a willingness to subsidize such costs for another Region (besides Sacramento) in California, but it appears that there are other candidates for this subsidy besides the Study Area. In view of the limited time available for the entire Phase III project (under one year) the uncertainty of such support is a significant factor.

Potential Benefits of the INDEX Assessment Tool

- *Broad Range of Indicators*

  - INDEX includes a total of over 70 indicators such as:

    - **Proximity to Amenities –** the walking distance to parks, schools, neighborhood retail, transit, or other walkable amenities.

- **Stormwater Run-off or Imperviousness –** to the extent that estimates can be made regarding the extent of impervious surface for different land use types, INDEX can report an estimate of stormwater run-off.

- **Other Transportation Indicators –** internal and external street connectivity, street network density, street route directness, pedestrian crossing distance, transit service coverage, etc. These are useful both for direct comparison between scenarios and to guide the 4D post-processing of standard transportation model outputs, see below.

➢ Facilitates 4D Analysis

  - INDEX can provide transportation modelers with the information necessary to understand how variations across scenarios in land use mix, intensity, and transportation network can affect travel demand.

➢ INDEX Sketch Planning and Analysis Tools

  - INDEX has the ability to “sketch” alternative scenarios within the modeling tool and then run indicators to allow comparisons between sketch alternatives.

INDEX Model Scope and Data Requirements

The following summarizes the functions and requirements of INDEX, the team’s first choice. This information is derived from documentation available from Criterion’s website and other sources as noted:

INDEX Geographic and temporal scope
INDEX can be applied to single neighborhoods, entire communities, and multi-jurisdiction regions. Its indicator measurements can be calculated at either the parcel level or at a larger user-defined area level, such as census blocks or traffic analysis zones.

INDEX 8 and other recent versions of INDEX are primarily intended to execute a static analysis of a single point in time. Prior versions have been used for dynamic analysis of a spatial growth forecast of up to 20 years, but such forecasts have been problematic and the intent in the current Study is to use INDEX to analyze scenarios at a single point in time. The Land Use Allocation Model (Category 1 model) discussed in the preceding section will be responsible for the dynamic, incremental spatial growth forecast in the Phase III Study.

INDEX hardware requirements
Minimum hardware requirements per Criterion include a 450 MHz PC with 128 MB of RAM, a 17-inch monitor capable of 800 x 600 resolution with 32-bit color, and up to 1.5 GB of hard disk space may be needed for applications. Increased capacities are advisable for model performance reasons and for analyses involving more than a few thousand analysis parcels (polygons).

INDEX software requirements
INDEX is built as an ArcGIS, ArcView, or MapObjects-based application using any Windows operating system. INDEX 8, the ArcGIS compatible version requires ArcEditor or ArcInfo. ArcView versions of INDEX require ArcView Network Analyst, and in some cases 3D Analyst and/or Spatial Analyst depending on customization specifications. Multi-Gen Paradigm SiteBuilder can be used for 4D modeling. Criterion is an ESRI Business Partner.

INDEX Data Requirements
Data needs for INDEX are determined by the scope and number of indicators in a given version. For the current version this is likely to include parcel-level GIS coverages of:

- Land-use (general plan category, COG-model trip generation category)
- Housing
- Employment
- Transportation (transit stops, and ideally street centerlines)
- Infrastructure (whether or not parcel is served)
- Natural environment (i.e., land classification, slope)

Other related community data (e.g. location of key public facilities such as schools) may also be included. Data availability is a key consideration in indicator selection and use. Most of the required input data for INDEX will come from the Land Use Allocation model. It will be necessary to independently develop future street and sidewalk network assumptions for local accessibility and walkability analysis; otherwise, these will need to be based on airline distances.

INDEX Standard Outputs
INDEX produces indicator results in numeric and map form; comparative charting of multiple case results; and documentation of all input parameters and assumptions. Optionally, scenarios can be visualized using 3-D modeling, photography, video, and drawings.

INDEX Run Times

While Criterion indicates that there is no upper limit on the number of GIS polygons. Runs times increase with the number of polygons (geographic units of analysis such as land use parcels, blocks, Traffic Analysis Zones, or Census tracts) and the number of indicators that need to be calculated. The City of Indianapolis has found that a SmartGrowth Index model with approximately 4,000 parcels and 29 indicators required approximately 20 minutes to run on a 1 GHz processor PC (Telecom with Russ McClure, City of Indianapolis, 6/11/03). By comparison, the Fresno County area is estimated to have approximately 250,000 land use parcels and 2,000 TAZs. Based on this, we do not anticipate running INDEX for the entire Study Area at a parcel level in real-time environment (e.g., a workshop or charrette). Workshops could either employ datasets at the TAZ level (or similar detail) or parcel-level detail for selected sub-areas, corridors or activity centers.

INDEX Data Checking

INDEX users in both the Indianapolis and the Charleston, SC Regions report that discontinuities in the GIS data (shapefile or line data) can result in termination of model runs. Criterion has developed error-checking utilities for its newer editions, including INDEX 8, which is intended to identify such problems. ArcInfo is the best tool for performing large-scale corrections to discontinuous geographic data.

Type II Recommended Model - INDEX 8

Based upon the above assessment, the Study Team recommends use of the INDEX 8 visualization and indicator model to model the Study Area.

Transportation Model Evaluation Process

Insensitivities of Conventional Modeling

Fresno COG and the Madera County Transportation Commission (MCTC) maintain countywide travel-forecasting models. These models, based on the TP+ software package, are conventional four-step traffic forecasting models that are similar in structure to most other regional models used in medium-to-large metropolitan areas. The models have been maintained and the Fresno COG model has been further enhanced with a mode split module in 2003, making it more up-to-date and versatile than many models in other regions. Unfortunately, even the best conventional models are insensitive to many local growth characteristics. For example, the effect that average block size or sidewalk completeness has on the propensity to walk does not appear in the typical traffic model and so improvements with these characteristics will have no effect on travel behavior.

The interactive land use/transportation evaluation that the Phase III Study entails requires fine-tuned assessment of the travel and related impacts of local urban character. This is too fine a scale to be reflected in the regional models, whose traffic zones typically contain hundreds of residents and or employees. Further, the Phase III Study requires quick-response evaluation of changes in regional spatial arrangements, responsiveness to transit and accessibility conditions not presently found in the Study Area, and rapid interface with the Indicator Visualization and Land Use models. It would not be practical to run the regional traffic models for each land use scenario, and, in any event the model was not sensitive to all the land use, transportation, and design features being tested.

While the main analytical tool for the forecasting long-term effects of land use on transportation networks in the Study Area is and will continue to be the Fresno COG and MCTC traffic models, the Study Team proposed to augment the Fresno COG and MCTC models with a process known as the 4Ds post-model process, and direct transit demand estimation. The purpose of both processes is to overcome the insensitivities of conventional modeling and so enable policy makers to get more reliable forecasts of the likely effects of the policies under consideration.

4D Methodology

Figure 2-1 includes a general overview of the steps involved when a 4D post-processor is used for travel forecasting, and how it relates to other models used in the Phase III Study. These steps begin with scenario assumptions that are generated by local agency staff or the Phase III stakeholders, with input and interpretation by the Study Team. These inputs may include changes to the transportation network. If so, these changes are made to the Fresno COG and MCTC models using network-editing software for each scenario. The assumptions about changes in land use are input to INDEX, which is used to determine the amount of each land use assigned to each TAZ. The land use files and the network files then serve as inputs to the Fresno COG and MCTC conventional four-step traffic models, and produce conventional forecasts for vehicle trips (VT) and vehicle miles traveled (VMT).

Up to this point the process is exactly like any conventional model. The 4D post-processing begins by computing the differences in such TAZ land use characteristics as residential density and retail/non-retail job mix. Assumptions are also made about differences in other characteristics that are not normally found in either land use or transportation models. These include such things as sidewalk completeness, block size, and route directness. Elasticities for each of these TAZ characteristics were computed from household survey data and can be applied to the percentage differences between the Initial Run and the scenario being tested. The results are adjustment factors for the forecast VT and VMT for each TAZ.

If separate elasticities were computed for each trip purpose then a different adjustment factor will be produced for each purpose. These adjustment factors are then applied to the original forecasts to produce the adjusted forecast for the scenario being tested. The adjusted forecast for the scenario can then be compared to the Initial Run forecast. This comparison included both the differences that conventional modeling would reveal and also differences that a conventional model would have missed.

4Ds Data

The heart of the 4D methodology lies in the elasticities that are used to adjust the VT and VMT forecast. These are computed based on data on actual travel behavior obtained from household surveys. Regression analysis is used to determine the effect that each of the four Ds (residential and job **density**, neighborhood **design**, **diversity** of land uses, and proximity to **destinations**) has on the number of vehicle trips and vehicle miles traveled while holding other factors (household size, income, etc.) constant. Different formulas are tried for each of the Ds until the formula most appropriate for local circumstances, in terms of statistical significance, is found. If any given characteristic is found not to have a statistically significant effect on travel behavior, to a high degree of confidence, it is not used.

Ideally the elasticities used in the Study Area would be based on local data. Most jurisdictions that have conventional traffic models have at least some local data that can be used in the 4D application. Since recent local survey data was not available for Fresno or Madera Counties, the Study Team drew on a growing library of national survey data on analogous regions.

With regard to specific data needs, the 4-Ds post processor requires the following information:

- Study Area totals of employees and population added/subtracted in scenario relative to Initial Run.
- TAZ maps showing number of employees and population added/subtracted relative to Initial Run.
- Study Area TP+ model-based transit network, including service frequencies, capacities and speeds.
- Study Area TP+ model highway network with congestion data (speeds or volume/capacity).
- Parcel or TAZ-level information regarding block size and sidewalks/pedestrian paths.

There are two operating environment options for performing 4Ds analysis:

1. Stand-alone spreadsheet.
2. Integrated module in INDEX model.

Option 1 is ready for implementation, while Option 2 is under investigation. Earlier versions of INDEX included a 4Ds analysis component, but the format and content of this utility have been superseded and would need to be updated.

Mode Split Estimation

As noted above, Fresno COG has a mode split model, which uses the comparative costs (in time, money and effort) to estimate shares of travel via transit, auto or non-motorized mode. This was the tool used for estimating regional transit patronage in Fresno County. A special transportation analysis zone was added to represent Madera County, enabling mode split to be estimated for inter-county travel in the SR 41 corridor. Given the accelerated time schedule for the Phase III study, and the location and conceptual nature of transit alternatives under consideration, this approach was adequate. In the future, development of a more detailed mode split model for Madera County may prove desirable.

General Description of Direct Transit Demand Estimation Methodology

To respond to the above issues, the Study Team developed a forecasting methodology that incorporates the following principal elements:

1. Forecast the major travel movements through transit corridors the Study Area using the Fresno COG and MCTC model. These macroscopic travel movements include: person-trip growth and distribution, transit trip re-routing resulting from completed transit network completion, ridership changes in response to transit frequency and speed.

2. Forecast boardings and alightings at individual new stations within the transit system based on empirical relationships found though statistical analysis of transit in other regions.

    - Station-area population and employment (within ½ mile)
    - Catchment-area population
    - Feeder bus service level
    - Parking spaces
    - Transit frequency

- Transit vehicle type (e.g., LRT versus Bus Rapid Transit)

Conclusions

This chapter has summarized the three types of models that were employed during Phase III of the Study and summarized the rationale for selected specific models. Specifically:

- *The tools add clarity and detail to the development of alternative development scenarios and a broader assessment of their relative impacts and benefits beyond what can be achieved using standard transportation modeling tools.*

- *The tools provide enhanced data for input into standard transportation modeling tools and facilitate the post-processing of standard modeling outputs to allow a more meaningful evaluation of potential impacts and benefits.*

- *The tools allow for a planning process that is more transparent and accessible to the public and decision-makers.*

- *The tools can facilitate a greater level of interactivity between the planning process and non-planners.*

- *The tools result in clearer communication of the choices and trade-offs between various alternative scenarios in map form, which are more understandable than outputs from standard transportation models.*

- *Lay people can actually take part in the land use and transportation decision-making process as well as understand the results of various land use scenarios on transportation, conservation, revitalization, and other factors.*

San Joaquin Valley Growth Response Study, Phase III
Fresno-Clovis-Southeast Madera Region
Demonstration Project

CHAPTER 3 – SELECTING THE SMART GROWTH MODELING INDICATORS

As indicated in Chapter 1, an extensive public outreach program accompanied Phase III of the San Joaquin Valley Growth Response Study (GRS). This effort included the involvement of elected officials and key stakeholders in the selection of smart growth indicators and alternatives. This chapter summarizes the indicator selection process.

Several presentations were provided to elected bodies in the summer of 2003, including an overview of Phase III of the GRS and a review of the indicator process to be applied. Attendees were informed that the Stakeholders Group, at its first workshop in June 2003, wanted the Team to first gain an understanding of the important indicators from the elected's and then come back to the Stakeholders with the results for further discussion. Following review of the indicator process, the elected bodies recommended analysis of the following Smart Growth indicators (not in priority order) or had the following comments:

- *Fresno County Board of Supervisors, Tuesday, July 28, 2003*
  - Air Quality
  - Public Transit
  - Congestion Relief
  - Education (need to improve major school districts)
  - Land consumption
  - Preservation of Ag Land
  - Impact on utilities and provision of services (especially emergency services and street and road improvements to increase safety)
  - Water quality and quantity
  - School Districts should be added to the Stakeholder Committee given the impact of new schools on growth and development

- *Clovis City Council, Monday, August 4, 2003*
  - Mayor Lynn Ashbeck commented that this was the first time she has heard of the study
  - Ms. Vivian indicated that the Team would be willing to meet with individual members of the Council to further discuss the Phase III process.
  - Ms. Vivian recommended that the Council provide its staff with a list of important indicators given the time constraint at the meeting
  - The Mayor also requested that the Phase III process should be an open process and that the Team should invite a variety of stakeholders

- Madera County Board of Supervisors, Tuesday, August 9, 2003
  - Water quality and quantity
  - Insure that consistent analysis of General Plan policies is provided between the two counties
  - Study the impact of an Avenue 9 connection between the two counties as one of the scenarios to be developed and analyzed as part of Phase III
  - Designating Avenue 9 as SR 145 and designating SR 145 as a County road
  - Insure that growth and development throughout the County is considered in the analysis. Major growth is occurring in the foothill areas (Oakhurst/Coarsegold) not in SE Madera County
  - Education
  - Jobs Housing Balance
  - Quality of Life issues such as safe communities, air quality, etc.
  - Concerns regarding opposing views on growth and development between the Fresno and Madera County General Plans. Fresno County directs growth to existing communities; whereas Madera County allows growth in rural areas
  - Concern about the unsuccessful regional cooperation with agencies in Fresno County, as was the case on the east-west corridor study
  - Concern about unnecessarily spending monies on studies that really won't benefit Madera County
  - Ms. Vivian indicated that the Team would be willing to meet with individual members of the Board to further discuss the Phase III process

- Fresno City Council, Tuesday, August 19, 2003
  - Dan Hobbs, City Manager, indicated that there is $1 million worth of projects to implement the General Plan. He asked how do you get from a modeling exercise to project or plan implementation. Ms. Vivian answered that as the model is further refined after this phase of the project, comparative analysis of development proposals at the community, neighborhood or parcel level would be possible.

- Important indicators and other comments included the following:
  - Emphasize housing, especially higher density housing that would cater to the younger (25-35 year old) generation
  - The environmental - air quality issue
  - Employment (create jobs in our area of high unemployment)
  - Tie housing, retail and transit use together. Reference was made to Manchester as an area where mixed use and enhanced transit may be viable. Reference was also made to the Tower District, characterized as a walkable area, which could be further designed to get people out of cars and into transit, bicycling, and walking
- Ms. Torres, a public member, expressed support for the project, indicating that proposed transit improvements need to be realistic. She saw a need for increased frequencies on key bus routes, the bus (FAX) needs to be affordable to everyone, and that there needs to be more shelters and safety at the stops.

Once the information and comments were received from the elected bodies, the lists of Smart Growth indicators were further refined by the Study Team and reviewed and finalized by the Stakeholders Group at its 2nd Workshop. The final lists of indicators are provided in Tables 3-1 and 3-2. Table 3-1 details the primary indicators that were addressed during development of the Initial Run and Alternative Scenarios. Table 3-2 provides a listing of secondary indicators that would be addressed, if possible during development of the Initial Run and Alternative Scenarios. In the end, most of the indicators in Table 3-1 were addressed; however, very few of the indicators listed in Table 3-2 were assessed due to budget and scheduling issues, or a lack of data in GIS format.

TABLE 3-1
PRIMARY SMART GROWTH INDICATORS

Indicator #	Indicator Categories/Indicators	Indicators Directly Available From Models	Candidates for Economic & Environ. Justice	Related General Plan Policies			
				City of Clovis	City of Fresno	Fresno County	Madera County
1	***Economics***				*	*	*
a	Travel cost ($/year/capita) to traveler by mode	Partially	X				
b	Infrastructure/Capital Facilities Costs - relative road, water, sewer, storm drain, education facility, and emergency service facilities costs	INDEX & Post-Process			*	*	*
c	Average cost fo real estate development	Partially					
2	***Congestion Relief***					*	
a	Vehicle hours of delay (hours/year/capita)	COG Models	X		2Ce, 2Ci, 2Cj	*	
b	Congestion (Lane Miles at LOS E/F) by Facility Type and Sub-Region in tabular format.	COG Models			2Ce, 2Ci, 2Cj	*	

TABLE 3-1 (Continued)
PRIMARY SMART GROWTH INDICATORS

Indicator #	Indicator Categories/Indicators	Indicators Directly Available From Models	Candidates for Economic & Environ. Justice	Related General Plan Policies: City of Clovis	City of Fresno	Fresno County	Madera County
3	***Improved Air Quality***				*	*	*
a	Air pollution (lbs/year/capita of non-attainment pollutants) emitted from light vehicles	Partially		3.3	Goal 6, Goal 9		1D3, 2C1, 2C2, 2G1
b	Air pollution (lbs/year/capita of non-attainment pollutants) emitted from heavy vehicles	Partially		3.3	Goal 6, Goal 9		1D3, 2C1, 2C2, 2G1
c	NOX and ROG emissions per vehicle mile traveled	Partially		3.3	Goal 9		1C1, 1C4, 1D3, 1E1, 2C2, 2G1
d	NOX and ROG emissions per trip	Partially		3.3	Goal 9		1C1, 1C4, 1D3, 1E1, 2C2, 2G1
e	Non-attainment emissions from transit vehicles/systems	Partially					

TABLE 3-1 (Continued)
PRIMARY SMART GROWTH INDICATORS

Indicator #	Indicator Categories/Indicators	Indicators Directly Available From Models	Candidates for Economic & Environ. Justice	Related General Plan Policies			
				City of Clovis	City of Fresno	Fresno County	Madera County
c	Population density	What if?		2.3	Goal 5, Goal 9 *	LU F3 LU F4	1C2
d	Employment density	What if?		2.3	Goal 5, Goal 9 *	LU F3 LU F4	1C2
e	Acres of agriculture remaining (orchards, crops, and grazing land)	What if?		3.2, 4.2	Goal 9, C2e, 2Cj, Elj, Elm *	LU F8 LUF10 LUF20	1D3, 2G1
f	Amount of water consumed. This may become a Tier 2 Indicator depending upon availability of information to convert different land uses and densities to water use.	Partial		4.1, 4.2,	E22-I, E22-j, E22-k	PF-C.25, PF-C.26*	3C1, 3C2,3C3, 3C8*
g	Acres of public parks per capita	INDEX		3.2, 4.2	Goal 9, C2e, 2Cj, Elj, Elm *	LU F8 LUF10 LUF20	1D3, 2G1

TABLE 3-1 (Continued)
PRIMARY SMART GROWTH INDICATORS

Indicator #	Indicator Categories/Indicators	Indicators Directly Available From Models	Candidates for Economic & Environ. Justice	Related General Plan Policies			
				City of Clovis	City of Fresno	Fresno County	Madera County
4	***Travel Time & Length (Jobs Housing Balance)***				*	*	*
a	Vehicle miles traveled (miles/year/capita)	INDEX / COG Models	X	3.3	Goal 9		1C1, 1C4, 1D3, 1E1, 2C2, 2G1
b	Vehicle hours traveled (hours/year/capita)	INDEX / COG Models	X		2Ce, 2Ci, 2Cj	*	*
c	Daily and Peak Hour Vehicle Trip Time (Minutes) by Trip Purpose	COG Models, INDEX, 4D		3.3	Goal 9		1C1, 1C4, 1D3, 1E1, 2C2, 2G1
d	Job proximity to services (1/4 mile walking distance, average for study region displayed graphically and in tabular format - how many jobs are within 1/4 mile of services).	INDEX		3.2	Elm	LU F8 PF 1.2	
5	***Land and Water Consumption***				*	*	*
a	Land area taken up by new growth (total acres and acres per 1000 population)	What if?		3.2, 4.2	Goal 9, C2e, 2Cj, Elj, Elm *	LU F8 LUF10 LUF20	1D3, 2G1

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TABLE 3-1 (Continued)
PRIMARY SMART GROWTH INDICATORS

Indicator #	Indicator Categories/Indicators	Indicators Directly Available From Models	Candidates for Economic & Environ. Justice	Related General Plan Policies			
				City of	City of	Fresno	Madera
6	***Travel Mode Shift/Viability of Increased Transit Usage***				*	*	
a	Population density in transit oriented area (w/in 1/2 mile of BRT or rail and w/in 1/4 mile of bus corridor)	INDEX	X	5.4, 5.6	A1h *	LU F3	1B2, 1C1, 1C2, 1D3, 1E1, 1F1
b	Employment density in transit oriented areas (w/in 1/2 mile of BRT or rail and w/in 1/4 mile of bus corridor)	INDEX	X	5.4, 5.6	A1h *	LU F3	1B2, 1C1, 1C2, 1D3, 1E1, 1F1
c	Mode split proxy (change in daily and peak hour vehicle trips by purpose)	INDEX / COG Models	X	3.1	Goal 6 *	TR B3	2C1

* *Indicator mentioned during SJVGRS Phase III presentations with Jurisdictions' elected officials*

TABLE 3-2
SECONDAY SMART GROWTH INDICATORS

Indicator #	Indicator Categories/Indicators	Indicators Directly Available From	Candidates for Economic & Environ.	Related General Plan Policies: City of Clovis	City of Fresno	Fresno County	Madera County
1	***Economics***						
d	Auto and transit vehicle costs						
e	Assessment of property taxes paid						
f	Housing density vs housing costs						
g	Private development cost savings						
2	***Congestion Relief***					*	
c	Congestion (Lane Miles at LOS E/F) by Facility Type and Sub-Region in graphic format (locations of LOS E or F freeway, expressway and major arterial segments).	COG Models			2Ce, 2Ci, 2Cj	*	
4	***Travel Time & Length (Jobs Housing Balance)***				*	*	*
e	Jobs/Housing Balance			1.2, 1.3	Goal 9, C2e *	LU F1 LU F2 LU F4 LUF27	1B2, 1F1, 1F2 *
f	*- Commute Travel Map (time to work from subareas of the region)*	INDEX	X		2Ce, 2Ci, 2Cj	*	*

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TABLE 3-2 (Continued)
SECONDAY SMART GROWTH INDICATORS

Indicator #	Indicator Categories/Indicators	Indicators Directly Available From Models	Candidates for Economic & Environ. Justice	Related General Plan Policies: City of Clovis	City of Fresno	Fresno County	Madera County
h	Transit miles and hours traveled	COG Models					
I	Housing proximity to school (1/4 mile walking distance)	INDEX	X	3.2	Elm	LU F8 PF 1.2	
j	Housing proximity to neighborhood shopping (1 mile bicycling distance)	INDEX	X	3.2	Elm	LU F8 PF 1.2	
5	***Land and Water Consumption***				*	*	*
h	Density Index (Population + Employment per Acre)	What if?		2.3	Goal 5, Goal 9 *	LU F3 LU F4	1C2
I	Acres of open space including: environmental preserves (private, local, county, state, and federally owned) and working landscapes (agriculture and grazing land)	INDEX		3.2, 4.2	Goal 9, C2e, 2Cj, Elj, Elm *	LU F8 LUF10 LUF20	1D3, 2G1
j	Consumption of agricultural land by crop classification to urban development						
6	***Travel Mode Shift/Viability of Increased Transit Usage***				*	*	
d	Vehicle trips (Daily and Peak Hour)	INDEX, 4D	X	3.3	Goal 6, Goal 9		1D3, 2C1, 2C2, 2G1
e	Bicycle usage						

* *Indicator mentioned during SJVGRS Phase III presentations with Jurisdictions' elected officials*

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CHAPTER 4 – DEVELOPING THE MODELING TOOLS

As indicated in Chapter 2, two GIS-based computer programs were used to allocate growth projections and to perform smart growth indicator evaluations of the scenarios that were developed for Phase III. This chapter discusses the two models, the data preparations that were undertaken to prepare for their use in the study, how the scenarios were developed and evaluated, and lessons that were learned that could improve the future applicability of the models.

What If? – Land Use Allocation Tool

What If? is an interactive GIS-based land use allocation model that allows users to visualize and evaluate the impacts of community–based alternative development scenarios or the implications of population growth trends in a community. The model utilizes Geographic Information System (GIS) data describing the community's land use, environmental, and demographic conditions to perform a land suitability analysis, project future land use demand based on user-defined demographic growth projections, allocate this demand to suitable locations, and evaluate the likely impacts of alternative land use and infrastructure policy choices and assumptions.

The model's minimum base data requirement is the community's existing land use data, although for this Study other data was acquired such as slopes, important farmland, and protected lands. From there, depending on the analysis that agencies within the Study Area wish to perform, the model will require existing and/or projected population and employment data (households, jobs and densities) and at least one control factor (e.g., infrastructure policy plans, General Plan land use policy, growth boundaries, protected lands). These geographical factors are combined into a single ArcGIS shapefile, referred to as a *UNION* file. Based on the control factors and user-defined parameters, the model ranks each parcel with a suitability factor that guides the allocation of growth. It then allocates growth to the parcels that are best suited for each land use type that is defined until the projected growth is fully allocated. Finally, *What If?* provides a future Land Use pattern shapefile, referred to as a *Uniform Analysis Zones* (*UAZ*) file that can be used in ESRI products and the INDEX model for further analysis and presentation.

Data Preparation

Acquisition of Data

The geographical data collected for input into the models included existing land use, General Plan or Community Plan land use policy, environmental factors (e.g., slopes, water bodies, soil quality, preserved lands), and transportation networks. The Study Team contacted various agencies to acquire local land use, environmental and transportation data. These included Fresno and Madera Counties, various individual incorporated jurisdictions, Caltrans District 6, California State University, Stanislaus (CSUS), local transit providers, and the county Assessor's offices. Some data was also acquired from State of California data sources via the CaSIL online website at http://gis.ca.gov. Detailed existing and planned infrastructure data was not available on a consistent basis for the Study Area. Demographic data was acquired from the Council of Fresno County Governments (Fresno COG) and the California Department of Finance (DOF), and analysis by the Study Team.

There were various obstacles to overcome in the acquisition of data as well as the preparation of data for input into the models. To begin with, there was no single or consistent organization or agency that creates or maintains GIS information for the Study Area. Neither had a body of regional data ever been effectively gathered to create a comprehensive and up-to-date database for the Study Area prior to this Study. This meant that the Study team had to make several contacts before reaching staff with adequate knowledge to glean the availability of various types of data and discuss the needs of the project. The data gathered typically did not include consistent geographic projections, organization, or terminology.

Generally, the level of GIS sophistication in the Study Area ranges from very comprehensive and up-to-date systems to non-existent. The General Plan land use policies, which acted as a control factor for the allocation of land uses, were particularly difficult to obtain in digital format, as the majority of jurisdictions in both counties did not maintain their own up-to-date GIS systems. Many relied on the counties to create or maintain this information. The Fresno County Planning Department is currently in the process of digitizing these plans into a GIS system. The Study Team worked with the

Fresno County Public Works & Planning Department to prioritize the data files. The department did provide data to the extent that it had been digitized and verified by the department for the Phase III project. General Plan land use policies for areas that were not available in digital format were substituted with land use data that was digitized under a program run by the Geography Department at CSU Stanislaus. Only the Cities of Fresno and Clovis maintained a comprehensive GIS data bank that included comprehensive land use policy information and some transit information.

Modification of Data

Geographic Correction

The GIS data obtained from different sources needed to be converted to ArcGIS shapefile format, reconfigured to a consistent geographic projection (NAD 1983) and modified to get proper alignments. Furthermore, the spatial layouts were adjusted to close gaps and avoid overlaps. The datasets were checked to remove inconsistencies such as duplicate and overlapping polygons.

Translation and Standardization of Data

Following this process, the data was reclassified in order to define a land use dataset with consistent land use and intensity definitions for the entire Study Area. This was necessary because each jurisdiction defines land use and densities in their own unique way, and maintaining these differences would exceed the capabilities of *What If?* All land use data, existing or plan policy, was standardized to a set of sixteen land use categories, the current limit of the *What If?* software. The intensity and use characteristics of the categories take into account the market analysis and trip generation rates for each of the land uses, as the model results would become the inputs into the transportation models. The sixteen categories are listed in Table 4-1 with their density ranges.

Referencing Table 4-2, Assessor's data was used to determine existing land use categories as well as to identify preserved agricultural and vacant lands for areas outside of the City of Fresno's Sphere of Influence. This was based on the assessor's Use Code, which had to be deciphered in order to translate them into useable land use categories. These codes had to be disaggregated and reclassified in order to provide a categorical system that was comprehensible to the models. This translation had to be performed for Fresno County (excluding the City of Fresno, which has its own existing land use geographic database) and Madera Counties separately as both have their own distinct and incompatible categorical systems. A sample table derived from the Assessor's data is shown below. The existing land use categories for the City of Fresno's Sphere of Influence were also re-categorized into the 16 land uses.

TABLE 4-1
WHAT IF? LAND USE CATEGORIES AND ASSOCIATED DENSITIES RANGES

	What If? Land Use Categories	Density Ranges [1]	Density Mid Point [2]	*What If?* Intensities (emp/ac) [3,4]	*What If?* Intensities (sq ft/emp)
1	Water Bodies (ND[5])				
2	Roads (R.O.W.) (ND[5])				
3	Agriculture				
4	Open Space (includes existing vacant)				
5	Park (ND[5])				
6	Rural Residential	0.11 to 1.50	0.50		
7	Low Density Residential	1.51 to 6.50	4.50		
8	Medium Density Residential	6.51 to 12.00	8.00		
9	High Density Residential	12.01 to 45.00	20.00		
10	Neighborhood Commercial	0.25 to 0.50	0.25	37.69	1,156
11	Community Commercial	0.25 to 1.00	0.25	36.38	1,197
12	Regional/Auto-Oriented Commercial	0.20 to 1.00	0.25	26.17	1,665
13	Industrial	0.20 to 1.50	0.20	10.65	4,090
14	Office	0.25 to 0.40	0.40	48.53	898
15	Schools	N/A	N/A	2.91	14,969
16	Other Public (ND[5])	N/A	N/A	18.52	2,352

Notes:
[1] Based on current General Plan policies and zoning ordinances.
[2] "Mid-point" density is not the average density, but rather the "market" mid-point.
[3] Employment densities for Neighborhood Commercial, Community Commercial, Industrial, and Office based on Fresno COG model densities.
[4] Employment densities for Regional/Auto-Oriented Commercial, Schools, and Other Public based on an aggregation of similar uses and their average densities calculated for vacant land areas within the City of Fresno.
[5] ND = Not Developable

TABLE 4-2
SAMPLE OF TRANSLATED ASSESSOR'S DATA

Assessor's Data				Derivation
Use Code	**Zoning**	**Primary Use**	**Secondary Use**	**Description**
SS01000	*S = Residential zoning*	*S01 = Single Residence*	*000 = Vacant*	*Low Density Residential /Rural Residential (based on size of Parcel)*

For the General Plan land uses, the consultant team researched the various land use definitions to reclassify them according to their definitions and densities. Existing land use designations differ in terms of density ranges and the specifics of commercial uses allowed from jurisdiction to jurisdiction. For example, jurisdictions often group a variety of governmental services into a "public" category, which could contain uses ranging from public utilities to schools to government offices. Based on background knowledge of the project team, policy document research and communications with the jurisdictions, these were disaggregated into categories to match the *What If?* set of categories, such as "public," "schools" and "office" to reflect the different trip generation rates for each of the land uses.

Data from Other Sources

Because digital versions of the land use policies for many small communities, as well as much of Fresno County unincorporated lands, were not available, GIS datasets had to be obtained from other sources, namely the website maintained by the Department of Geography at CSU Stanislaus. These datasets were likely reclassified into generalized land use classifications for the purposes of that project. To a large degree, these reclassified datasets were adequate proxies for the remainder of the Study Area land use coverage. The website is supported by the Public Policy Institute of California and the Great Valley Center of the Central Valley.

As a final task, all of the datasets gathered were clipped to the defined Study Area boundary determined early in the process. The boundaries were based on the geographic extents of specific Traffic Analysis Zones (TAZs) to facilitate the interface between the land use allocation and visualization models, and the transportation models.

INDEX – Smart Growth Indicator Assessment Tool

INDEX is a suite of interactive GIS-based planning support tools that integrate with ArcGIS software. The suite of tools allows users to measure existing conditions, develop alternative land use scenarios, and evaluate the alternative plans. As a visioning tool, INDEX allows users to create alternative scenarios at scales ranging from the neighborhood to the region. Using a fairly comprehensive set of pre-determined indicators, the software can measure the success of the scenarios based on the goals and priorities that the community has established. Once plans are adopted, INDEX can also be used to monitor the success of implementation efforts.

The Phase III Study did not use all the functions of INDEX as *What If?* provides a more refined growth allocation function; rather the smart growth indicator evaluation portion of the INDEX suite was used in order to provide direct evaluation for some indicators and to provide information for use in the 4-D's post-processing of the traffic model outputs.

INDEX creates a set of geodatabases from the various shapefile inputs (land use, planned use, road, transit lines, etc). Non-spatial data, such as densities, need to be defined for each of the land uses. This can be done prior to loading the data as well as when editing the geodatabase. Each parcel is weighted for the indicators specified by the user. The end result is an evaluation of the land use pattern as per their performance on the selected indicator.

TP+ and the 4D Process – Transportation Model Assessment Tool

The Phase III transportation modeling process was built upon the existing TP+ models developed by the Fresno COG and MCTC. The base models for the Phase III Study were obtained from Fresno COG and MCTC in September 2003.

The Fresno County TP+ model was developed over a period of two decades. Its detailed network and zone structure covers only Fresno County. During the 1990s, a peak hour module was added. In 2003, a transit network and mode split sub-model were developed; this version of model was used in the Phase III Study.[1] This project further developed the transit network and mode split sub-model and applied them to all future (i.e., Year 2034) scenarios.

[1] For full documentation see *Fresno County Travel Model Mode Choice Update*, Council of Fresno County Governments, August 14, 2003.

The Madera County model dates to 1994, and the version used as the basis for this study was revised and calibrated in 2001.[2] In contrast to the single-county Fresno County model, the Madera County model covers three counties (Madera, Merced, and Fresno) and part of a fourth (Stanislaus), but is only a daily vehicular model. There is a difference in the types of trip purposes tracked by the two models. They also handle external trips differently. The Fresno County model uses external trips to balance excess trip productions or attractions in the modeling area. The Madera County model has detailed land use for all adjacent counties, so that trips external to Madera County are still internal to the modeling areas. For this reason, the Madera County model was used to determine inter-county trips traveling between Fresno and Madera Counties.

Tests of Models

Prior to the study, both models had been calibrated and validated to the satisfaction of the agencies that maintain them. However, since an important goal of the Phase III Study was to model population and employment growth of a higher magnitude than done in any prior analysis, both models were examined and tested in a number of ways. In a series of "proto-scenario tests", the Study Team performed numerous model runs incorporating substantial changes in land use. For example the Fresno County model was run after increasing all residential densities by 10 percent. Two separate runs added 5,000 households and 5,000 service employees to the Woodward Park area (representing infill of a typical suburban area). The Study Team also performed similar tests of infill development in the downtown Fresno zones. Measures tracked include Mode Split, Vehicle Trips, Vehicle Miles Traveled (VMT), Vehicle Hours Traveled (VHT) and Vehicle Hours of Delay (VHD) These were tracked both for the district receiving the additional development and model-wide.

Results were found to be reasonable; trips and vehicle miles traveled rose nearly proportionately with trip generation under the suburban-infill scenario; vehicle hours traveled increased more (reflecting congested segments) and VHD up most of all, reflecting a relatively low baseline of delay/congestion in 1998. The infill development in downtown zones resulted in relatively lower VMT increases compared to suburban infill.

Similar tests were performed for the Madera County model (e.g., adding 5,000 dwelling units just north of the County line/San Joaquin River and tracking similar measures – Vehicle Trips, VMT, VHT, and VHD). Results here were also reasonable.

[2] The model and the update are documented in *Madera County Travel Forecasting Model*, Korve Engineering, August 27, 2001.

The Study Team also examined link volumes in the Madera County model for the major highways that connect the two counties (SR 41 and SR 99) for comparison with Fresno County volumes (in the Fresno County model these are gateways). These confirmed that the two models had similar volumes on inter-county links (this has been a goal of modelers in both counties).

On the basis of these tests, a process for integrating the modeling results for the two models was devised. This process is described in detail in Appendix A.

In summary, both models performed relatively well by the usual standards for traditional four-step models within their respective county boundaries. Model inputs and results for both did indicate that neither model was sensitive to local urban form and design factors. Since local urban form alternatives were of central concern in the Phase III Study, a "4D's" processor was developed to work in conjunction with the TP+ models to better capture such urban form and design effects on trip-making.

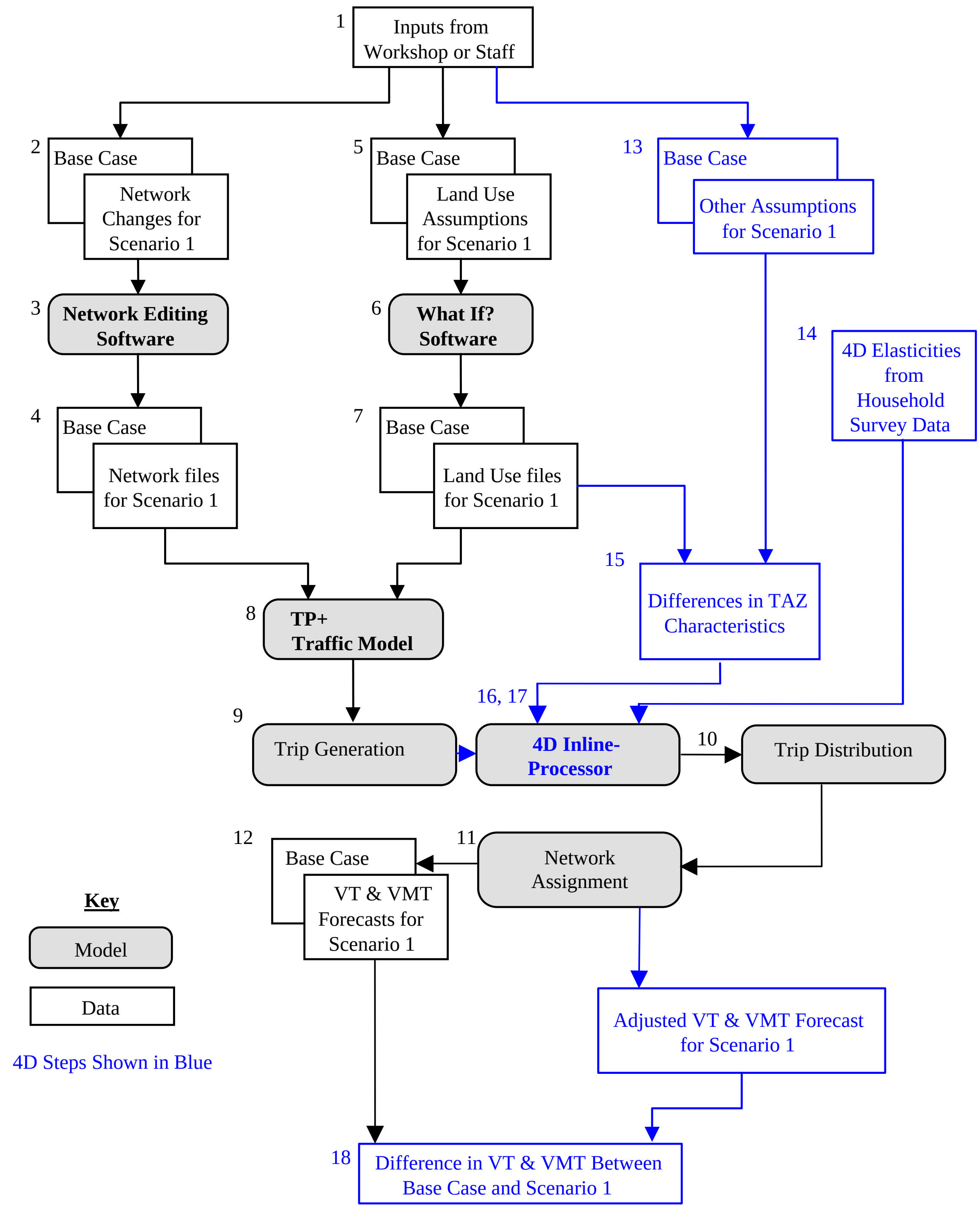
Overview of Travel Forecasting With a 4D In-line Processor

Extensive research on travel behavior clearly substantiates that 4 "D" variables (land use **density**, **diversity**, pedestrian **design** and access to regional **destinations**) affect travel demand. Because these four D's work at a very local level, most travel demand models are too gross in scale to capture the effects of the 4D's. A regional travel demand model's traffic analysis zones (TAZs) are typically too large, and their trip generation models do not consider local density and design variables.

A process was developed that enabled the Fresno and Madera County TP+ models to more fully capture the effects of the 4Ds. This process essentially modified trip generation rates to reflect the effects of localized changes in the 4D variables. It was implemented either as a stand-alone analysis tool, or as an intermediate step between trip generation and trip distribution in a TP+ models. At the core of the method are elasticities. Elasticity is defined as the percentage change in one variable that occurs given a percentage change in another variable. In the case of the 4Ds adjustments, we are interested in the change in vehicle trips generated in a planning area given a change in each of the 4D variables.

Figure 4-1 provides a general overview of the steps involved when the 4D in-line-processor is used for travel forecasting ("in-line" means that the effects of the 4D's are integrated with the four-step TP+ models).

FIGURE 4-1
RECOMMENDED PHASE III MODELING PROCESS



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The process begins with land use scenario assumptions, which may be generated by participants in workshops, consultants and/or local agency staff (1). These inputs may include changes to the transportation network (2).

If so, these changes are made using network editing software (3), to prepare the network files for each scenario (4). The assumptions about changes in land use (5) are quantified from What If? Outputs from GIS or other land use software (6), which is used to determine the amount of each land use assigned to each TAZ (7). The land use files and the network files then serve as inputs to the conventional TP+ travel demand models maintained by Fresno COG and MCTC (8), and produce conventional forecasts (9 -12) for vehicle trips (VT) and vehicle miles traveled (VMT).

Up to this point the process is exactly like any conventional four-step modeling effort. The 4D in-line-processing begins by computing the differences between the Initial Run (i.e., the Base Case in the Phase III Study) and each Alternative Scenario in such TAZ land use characteristics as residential density and retail/non-retail job mix (13). Differences in other characteristics that are not normally picked up in either the land use or transportation models may also be computed. This includes such things as sidewalk completeness, block size, and route directness (15). Elasticities for each of these TAZ characteristics were computed from household survey data (14) and can be applied to the percentage differences in density, diversity and design between the Initial Run and the scenario being tested (16). The results are adjustment factors for the person trip generation for each TAZ (17).

Separate elasticities have been computed for different trip purposes; therefore, different adjustment factors are produced for each purpose. These adjustment factors are then applied to the trip generation module, and the remainder of the travel demand modeling process proceeds normally to produce the adjusted forecast for the scenario being tested (18). The adjusted forecast for the scenario is then compared to the Initial Run forecast (19). This comparison will include both the differences that conventional modeling would reveal and the differences that a conventional model would have missed.

It should be noted that when used in conjunction with a four-step model, the effects of the fourth D (regional destinations) may be effectively handled by the model's trip distribution process. This was the case with the Phase III Study.

Reference Appendix B for details of the 4D modeling process as implemented for the Phase III Study.

CHAPTER 5 – PREPARING THE INITIAL RUN SCENARIO

The Initial Run Scenario was based on current land use policy from each of the jurisdictions for areas within the Study Area. This was the main control factor for the allocation of jobs and households. However, because each jurisdiction based their General Plans on different build-out years, the Study Team had to determine a target year for build out of the Study Area in order to establish the growth projections for populations and jobs. It was decided that the build out year should be derived from the build out of the City of Fresno, which is where the majority of growth is occurring in the Study Area.

Based on the existing land use data acquired from the City of Fresno, redevelopable lands were identified. Redevelopable lands included those parcels designated as “vacant,” “Rural Residential,” “Agricultural,” and non-preserved “Open Space.” These were analyzed for employment and housing capacity that could be accommodated within the City of Fresno’s Sphere of Influence (SOI) based on the Fresno COG growth projections for the City at the Traffic Analysis Zone (TAZ) level. Redevelopment was not factored in, as it was not possible to ascertain the amount of redevelopment that would occur within the SOI based on the existing and General Plan land uses and the Fresno COG data.

The resulting build-out year of 2034 resulted from the amount of time needed for future growth to exhaust both the employment and housing capacity within the City of Fresno SOI. However, by 2034, given the extent to which employment growth will exceed residential growth in the City of Fresno, approximately 25,600 additional households will need to be accommodated outside of the City of Fresno. These were allocated to the remainder of the Study Area communities in addition to the growth that was already projected for these communities. Table 5-1 shows the assumptions and results of this analysis. Growth rates and distributions were based on the Fresno COG assumptions.

TABLE 5-1
2034 INITIAL RUN SCENARIO POPULATION AND HOUSEHOLDS

Item	Assumptions		2003-2025	2025-2034	2003-2034
Fresno County					
New Households - Total (1)			163,696	77,853	241,549
Household Distribution (2)					
Single Family		66%	108,745	51,718	160,463
Multi Family		34%	54,951	26,134	81,085
Total New Households		100%	163,696	77,853	241,549
New Population (3)					
Single Family	66%	3.28 pers/hhld	356,821	169,701	526,522
Multi Family	34%	2.78 pers/hhld	152,844	72,692	225,536
New Population - Total	100%	3.11 pers/hhld	509,665	242,393	752,058
Madera County					
New Households - Total (1)			33,250	30,071	63,320
Household Distribution (2)					
Single Family		80%	131,244	62,419	193,662
Multi Family		20%	32,452	15,434	47,886
Total New Households		100%	33,250	30,071	63,320
New Population (3)					
Single Family	80%	3.28 pers/hhld	87,472	79,109	166,581
Multi Family	20%	2.78 pers/hhld	18,334	16,582	34,916
New Population - Total	100%	3.18 pers/hhld	105,806	95,691	201,497

Source: Economic and Planning Systems

The What If? Model

The following section describes the methodology used to allocate growth for the Initial Run Scenario. The model runs for the alternative scenarios were very similar with variations described later in this Report.

Creating the UNION File

As mentioned earlier, the input for the *What If?* land use allocation model is a UNION file. This file is created in GIS and is comprised of all of the geographical controls that will guide the allocation of growth to the physical space, in this case, the parcel level. The UNION file for the Initial Run was comprised of several layers of geographic information including: existing land use, General Plan/Community Plan land use policy, regional and community scale growth patterns, soil types, slopes, vacant lands, and preserved lands based on ten and twenty-year Williamson Act contracts. Soil types included prime agricultural land designations based on State of California data. The data was then “clipped” to the Study Area boundary and loaded onto the *What If?* model. All inputs, except the growth patterns, were derived from data gathered from the various local and state agencies.

The growth patterns prioritized growth allocations over the Study Area. For this Study two growth patterns were created to guide the allocation of growth, a *regional* pattern that defined a hierarchy of growth amongst the various jurisdictions and communities within the Study Area, and a *community* pattern that defined allocation priorities within the spheres of influence for each of the jurisdictions. Both considered “suitability” parameters as defined below. The Study Team constructed these growth patterns based on market preferences (reference Appendix C), which were then mapped and merged with the prepared land use GIS data set (reference Figure 5-1).

In the creation of the UNION file, a work-around to the 16-land use limit of the *What If?* model was needed in order to account for additional land use types that were essential to the analysis. This was done by creating a *Vacant* suitability. This attribute allows the identification of vacant parcels, which were included in the *Open Space* land use category, by giving them a “V” suitability. When the data is input into the *What If?* model, parcels with a “V” suitability are given a high allocation priority giving them a higher likelihood of being developed. The suitability attribute is defined as follows:

-

FIGURE 5-1
REGIONAL AND COMMUNITY GROWTH PATTERNS
CONSIDERING SUITABILITY PARAMETERS

- “Suitability” Parameters
  - Agricultural preserved lands
  - Vacant lands
  - Slopes
  - Soils
  - Growth Patterns

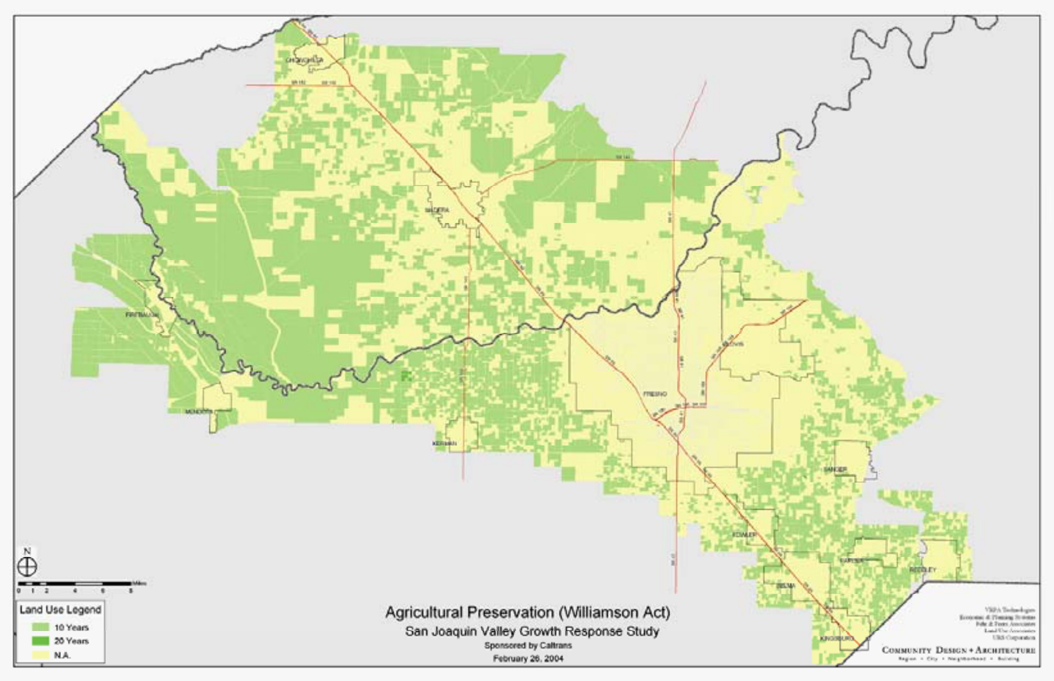

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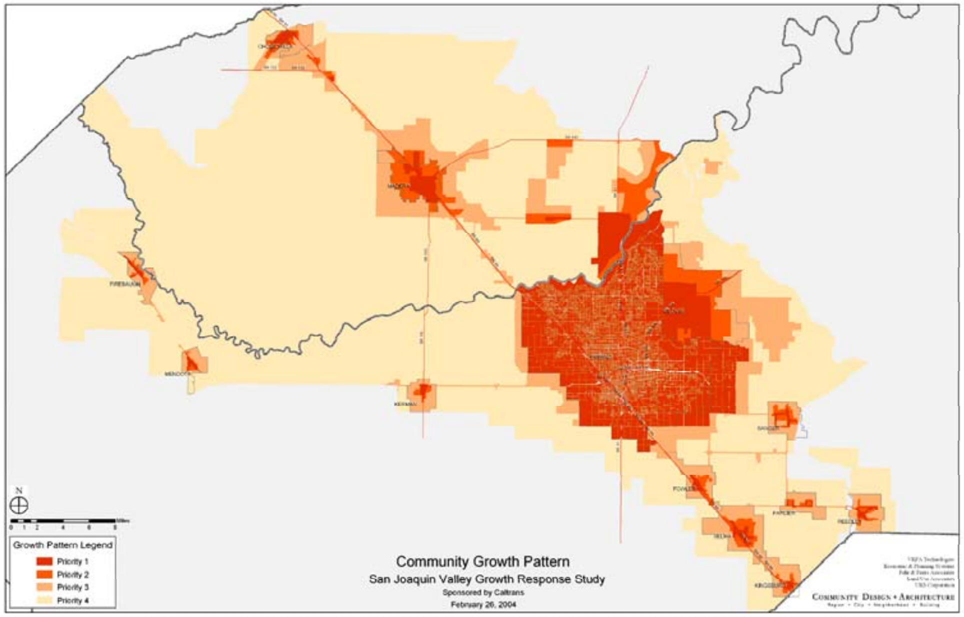
FIGURE 5-1 (Continued)
REGIONAL AND COMMUNITY GROWTH PATTERNS
CONSIDERING SUITABILITY PARAMETERS

- "Suitability" Parameters
  - Agricultural preserved lands
  - Vacant lands
  - Slopes
  - Soils
  - Growth Patterns within communities



Priority 1. V – Vacant parcels. Given high development priority
Priority 2. D – Non-vacant parcels. Developed parcels that can redevelop
Priority 3. N.A. – Not Applicable. This fills in null values for Non-Open space records, since the program cannot handle blank cells
Priority 4. ND – Not Developable. This indicates preserved open space

Finally, because the Initial Run assumed that the City of Fresno's SOI would build out and the model would not be required to allocate growth within the SOI, the land area within this boundary was not run through *What If?* leaving a void within the shapefile both in terms of geography and data. This data "gap" was filled with data and mapping prepared by the consultants in ArcGIS and integrated back into the scenario prior to INDEX and TP+ analysis.

Running What If?

Once the UNION file was loaded into the *What If?* model, allocation parameters were defined to steer growth in the direction desired. Although the communities' land use policies played a major part in determining which parcels could redevelop into higher densities or other uses, there are a number of other factors that must be defined prior to running *What If?.*

Growth projections for each land use category were entered to define the future demand for each land use type. These growth allocations were determined based on an estimate of market demand for various housing types and job categories (reference Appendix C).

Each residential category was assigned a total number of households. Similarly, each commercial or employment land use category was assigned a total amount of jobs. The conversion of these demographic assignments by the density and intensity of each land use category results in the demand for future land area. Land allocation associated with public services such as civic uses and parks were made on a land area per person basis, for example park acreage per 1000 households. These average civic and parks ratios for the entire Study Area were determined based upon the range of existing policies and the Study Team's experience in planning for growth in the Study Area. Neither the amount of infill development nor the amount of land for conservation were defined for the model runs as this was controlled by each communities' land use policy plan; certain existing land uses were allowed to convert to a General Plan's designation for a property if the new use was more intensive.

The *What If?* model then converts the demographic demand to land area demand, which is the output of the allocation model run. Overall, the model was set up to avoid developing and redeveloping preserved open space, lands with prime agricultural soils and other farmland, and existing parks, while steering growth towards parcels identified as vacant and/or suitable for redevelopment. Figures 5-2 through 5-4 provide a graphic display of existing land uses in GIS format within the Study Area and the results of the WhatIf? allocations for the Initial Run (General Plan) and Build-Out scenarios.

FIGURE 5-2
2003 EXISTING LAND USE

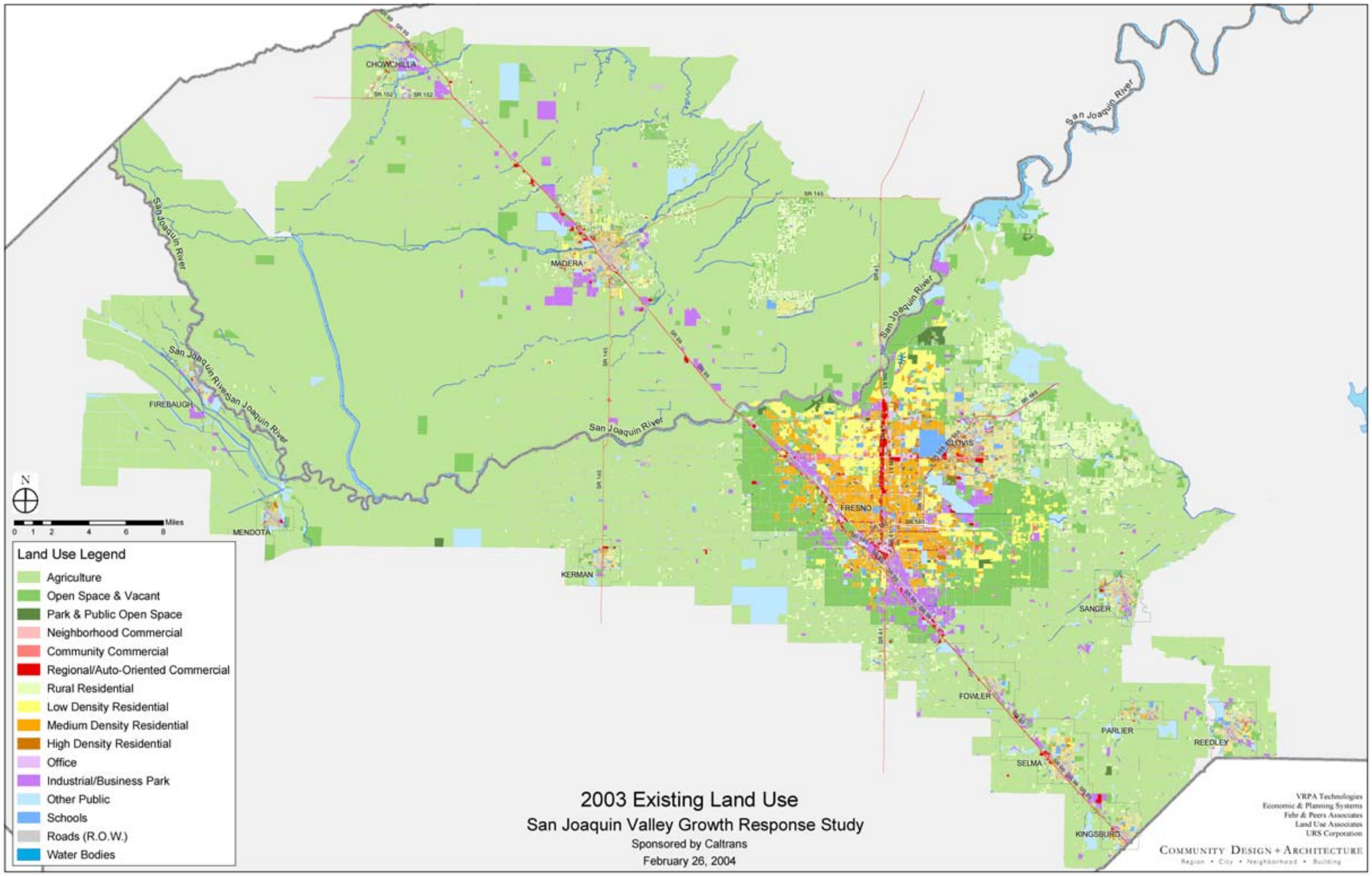


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FIGURE 5-3
2025 GENERAL PLAN LAND USE

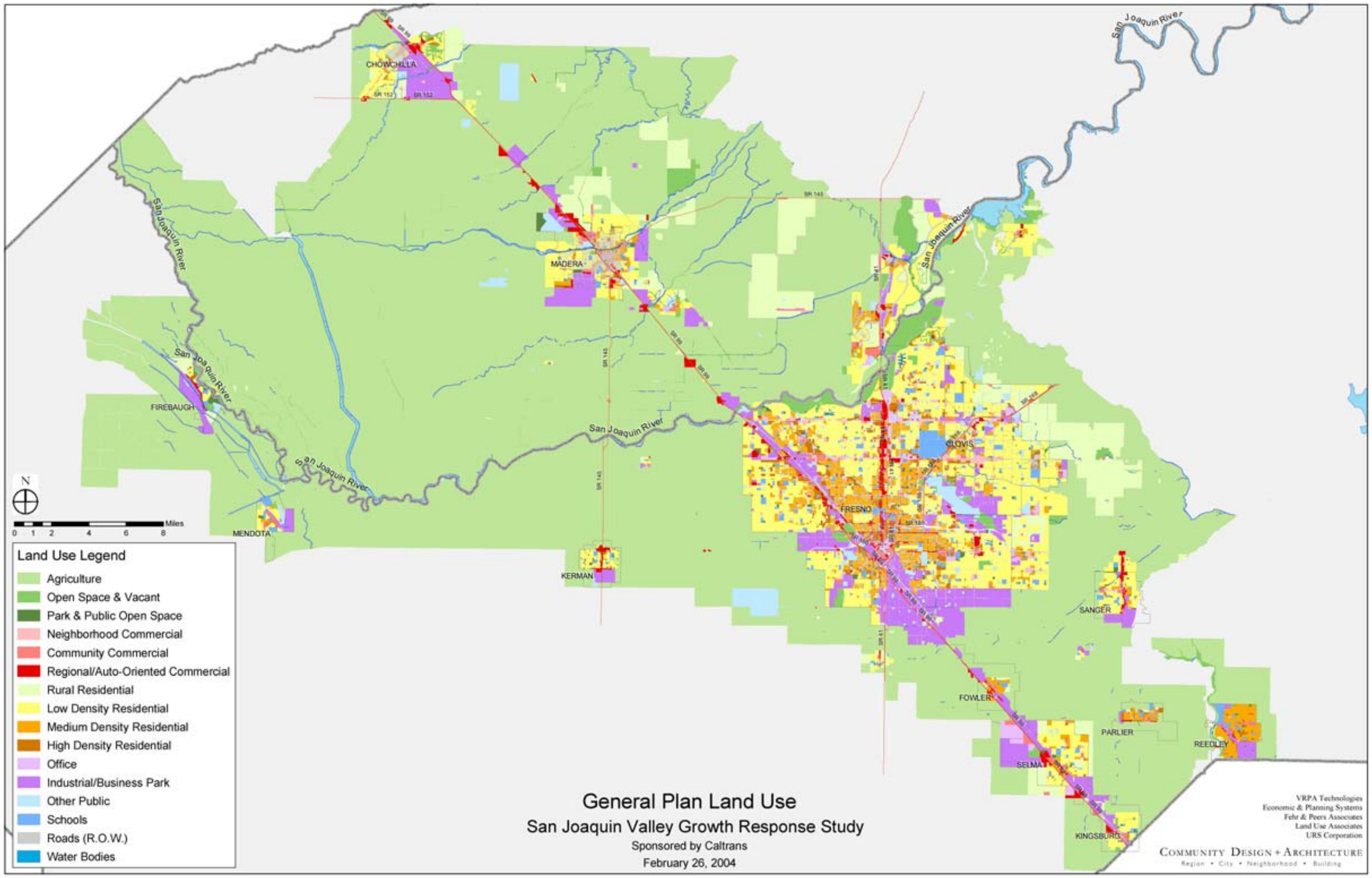

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FIGURE 5-4
2034 BUILD OUT LAND USE

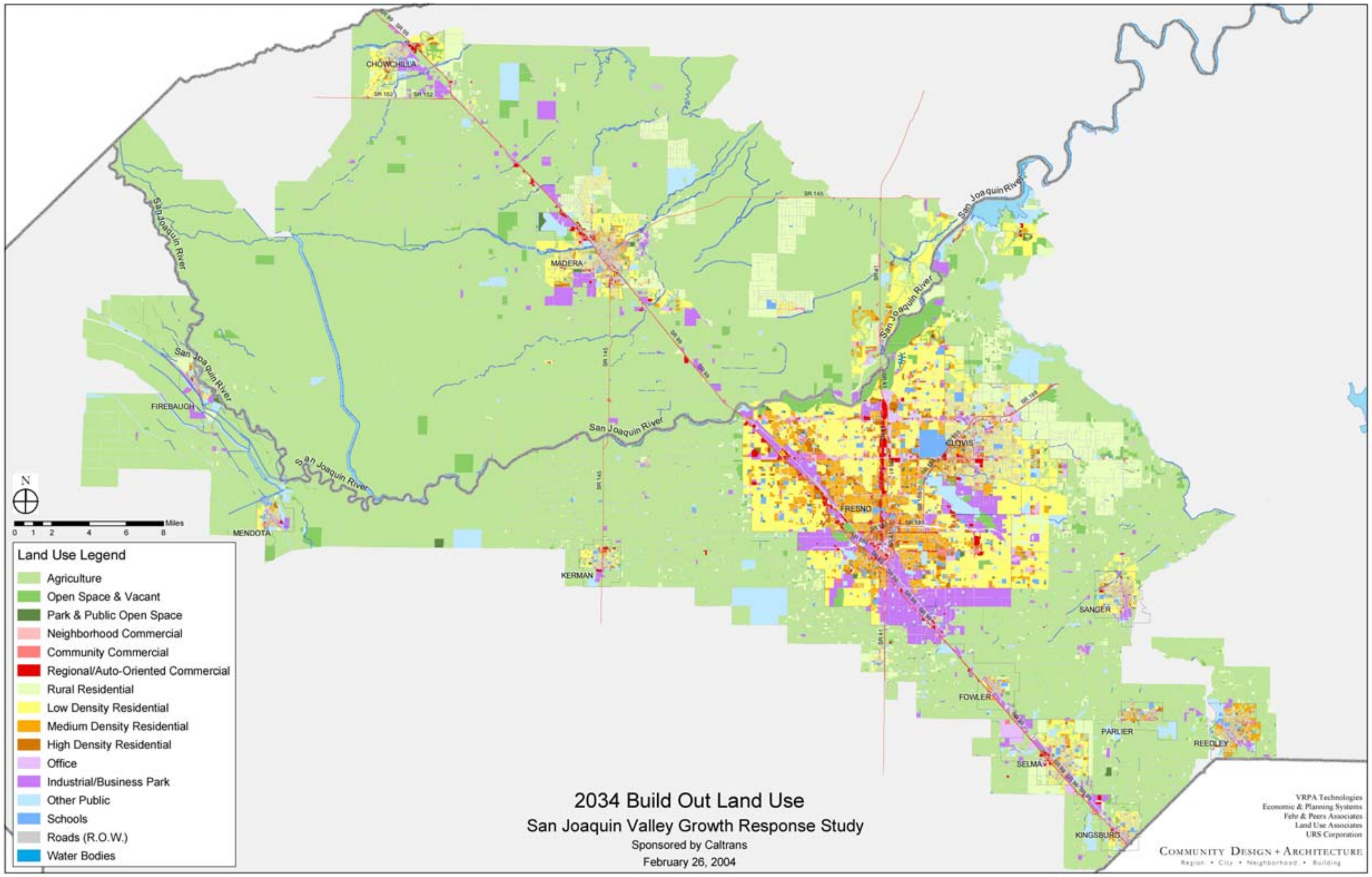

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Table 5-2 provides compares 2003 versus the Initial Run Scenario *WhatIf?* land allocation results for both Fresno and Madera County portions of the Study Area.

TABLE 5-2
LAND ALLOCATION RESULTS 2003 VS INITIAL RUN

Fresno Co.	Households	% Change	Jobs	% Change
Existing 2003	247,800		317,400	
Initial Run	450,300	82%	678,400	114%
Madera Co.	**Households**	**% Change**	**Jobs**	**% Change**
Existing 2003	27,100		30,700	
Initial Run	83,800	209%	50,600	65%

The resulting *What If?* output (reference Figures 5-2 through 5-4) was then post-processed to become the input data for the three subsequent models INDEX, TP+ and the 4Ds models. In general, the post-processing was a detailed and complex process as the INDEX and TP+ models require specific jobs and households categories in order to function properly. This is due to the fact that model outputs must be pre- and post-processed to convert data into an input format that the subsequent models can understand. The steps taken to post-process the data for input into the models are discussed below.

Preliminary runs of the model resulted in errors that would prevent the full allocation of growth to the Study Area. After some investigation it was discovered that the current model structure has the potential to result in over-allocation of growth, because its limited land use categories did not have the capability to account for differences in development intensity between existing and future development for a particular land use category. This may lead to an excess allocation of land to a particular use that has been displaced by new development because the program cannot account for greater efficiencies in the use of land by more intense development. It was, therefore, necessary to analyze the available capacity, as provided by the communities' General Plans, to ensure that the model had sufficient capacity to allocate the projected growth, as well as making shifts in the *What If?* demand factors to reflect "true" future market demand. This verification process was performed for each of the model runs.

The INDEX Model

INDEX was used in the Phase III Study both to provide assessment of the scenarios using a set of smart growth indicators as well as to provide data used to shape the 4Ds post-processing of the TP+ model outputs.

Preparing and Creating Data for the INDEX Model

Because *What If?* outputs result in land use by acreage for each of the 16 land uses, the data had to be reconfigured to provide a dataset that met the requirements of INDEX prior to running the model. The required inputs for the INDEX model are number of single-family units, multi-family units and jobs, as well as classification of land uses per the model's own 10 categories. Because both the reclassification of land uses from 16 to 10 and the summation of total employment was a fairly simple task of aggregating data, these conversions were little time and effort. On the other hand, residential conversions were particularly cumbersome to calculate because the Low Density and Medium Density residential types used in the *What If?* model include a relatively broad range of densities within each category, and both categories contain both single-family and multi-family housing types.

Based on assumptions provided by the Study Team, the residential data was redistributed accordingly: Low Density (80% S.F. / 20% M.F.) and Medium Density Residential (65% S.F./ 35% M.F). To map the multi-family distribution, parcels under the two categories that were in close proximity to Community Commercial uses (generally within 500 feet) were selected and labeled as multi-family. This operation was incrementally applied until the required multi-family land area was achieved.

These conversions from the 16 land use categories to the residential splits and employment numbers are critical for many of the indicators that the project was able to run given the available data acquired from the various local and state agencies. These included: Population Density, Use Mix, Single-Family/Multi-family Dwelling Share, and Single-Family/Multi-family Density. In addition, because the *What If?* results did not include the City of Fresno's SOI, the City of Fresno land use shapefile and associated database had to go through similar post-processing steps prior to being joined to the *What If?* shapefile for use in INDEX.

The transit lines were manually created in GIS based from transit line maps acquired from both the FAX and Stageline websites. INDEX used this polyline file to run the transit adjacency indicator by finding residential and commercial parcels that are within a set distance, which for this project was a 1/4 mile distance, of the transit network. For the Use Mix indicator, two components were necessary: the Study Area boundary, created in GIS, and definition of the optimum walking distance, which was defined as a quarter mile distance for the GRS scenarios. The Use Mix indicator then divided the Study Area into cells of one square quarter mile and determines diversity of use in relation to a central cell and its surrounding cells.

It should be noted that due to the large geographical size and the volume of data associated with the Study Area, running INDEX would have taken fairly large amounts of time and processing power. To counter this, the Study Area was split into three parts: City of Fresno and its immediate areas, including City of Clovis and Southeast Madera County; the remainder of Madera County within the Study Area; and the rest of Fresno County within the Study Area. This helped to speed up the processing time for initial runs of an indicator allowing for more frequent refinement of data and additional model runs needed to get indicators to run correctly. This additional efficiency in refining the runs for each indicator balanced the additional time needed for the more numerous runs and time spent recombining the three sub-areas into the full Study Area.

Running INDEX

The first step for INDEX was to load all of the above shapefiles into an INDEX "project." The process helps to identify potential issues with the shapefiles such as remnant polygons that contain insignificant data for analytical purposes and that can create errors in the analysis. As errors are identified corrections are made to the shapefiles and they are reloaded into the project. Once loaded, the data sets are displayed as a map and can be edited to calculate employment, households, etc. However, since these were calculated prior to loading the data, the primary purpose of this editing was to verify that INDEX had identified the data accurately. Inputs, such as walkable distance were entered while editing the Study Area boundary. After making sure that the loaded datasets were being read and displayed correctly by INDEX, the desired indicators were selected and the program was executed. Due to the large dataset size (above 20,000 features per sub area, the indicator processing took a fairly long time to calculate, approximately 1-3 hours for each run. A 'feature' is a geographically mapped polygon, line or point, in a GIS program. The GIS program can link features to a database containing data describing aspects of each particular feature. For example, a polygon visually depicted in map form by the software may represent a parcel of land.

GIS can link that feature to a database that contains information such as size, ownership, address, current land use, planned land use for that particular feature. A point may represent a bus stop in a specific location. GIS can link that feature to data describing the bus stop such as specific intersection, bus route number, frequency of service, etc.
Once the indicators were calculated they were displayed in map and summary tabular formats to verify the accuracy of the model runs. Some errors were detected in the review of the indicators and the model's author, Criterion, provided programming patches to fix errors that resulted from programming rather than data issues.

Because INDEX had to be run in sets, a total of six runs were performed for the Initial Run – three runs to measure the indicators for existing conditions and three for the future distribution. The results of this process are graphically displayed in Figures 5-5 through 5-16.

The Transportation Model

What If? and TP+ Model Interface

The *What If?* output also provided the primary base data for TP+ modeling, the transportation model used in both Madera and Fresno counties. Since the TP+ Model utilizes Traffic Analysis Zones (TAZs) as its "geographic" increment for employment and household demographics, the *What If?* output had to be converted into a dataset organized by TAZ. In order to prepare the *What If?* output for input into the TP+ model, the existing and *What If?* output shapefile were superimposed with a TAZ Map to distribute the land use allocation data by TAZ. The resulting shapefile databases were converted into Excel spreadsheets for future processing. The land area data was converted to household and employment numbers under the *What If?* categories by TAZ and was compared with control totals to check for discrepancies. The data was then converted to the household and employment categories that are required for the TP+ model.

What If?, INDEX and 4D Model Interface

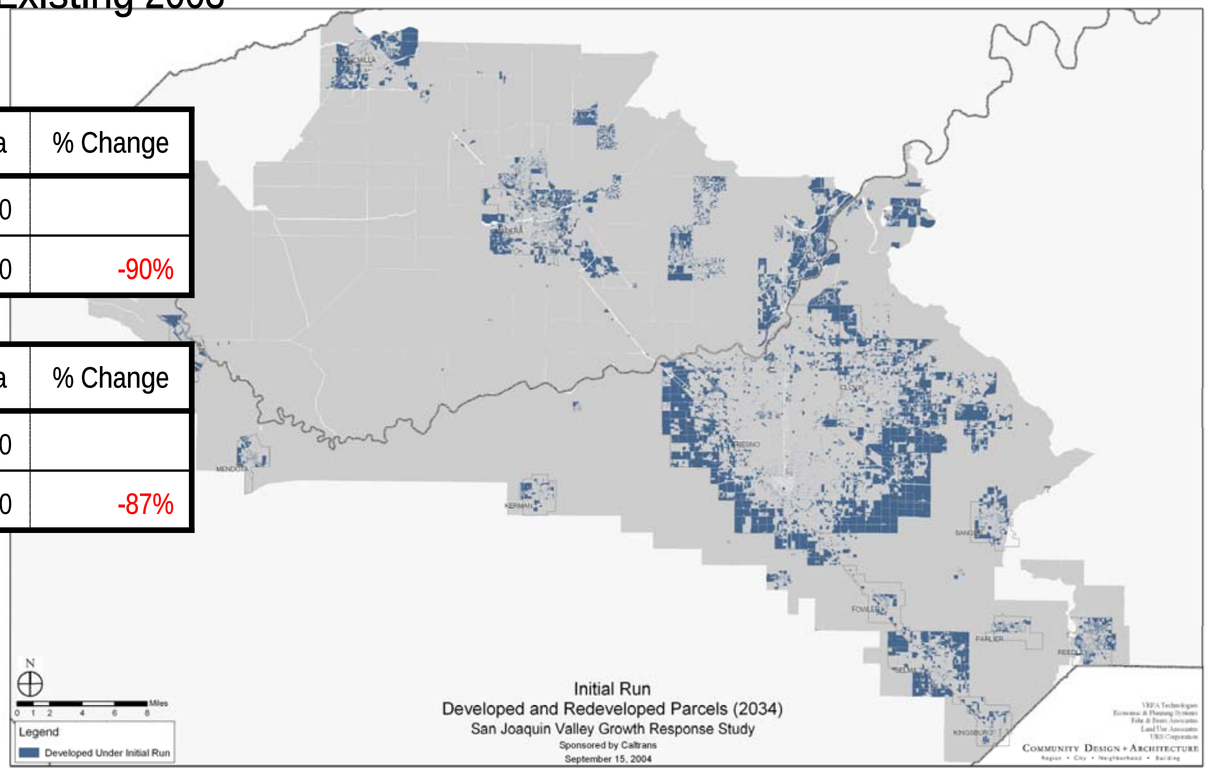
Neither the results from the *What If?* nor the INDEX models served as direct inputs into the 4D model. However, INDEX was used to provide a sampling measurement of walking distance to services for the 4D analysis. A sampling of areas within the City of Fresno was used to test a variety of areas with differing block sizes and, therefore, differing distances to intersections. A route network was manually created in GIS by identifying the center point for each block and distances calculated using INDEX. The sample distances were then used in the 4D analysis to estimate 4D travel behavior factors to apply to different parts of the Study Area given their relative similarity to the street network and urban form of the sample areas.

FIGURE 5-5
DEVELOPABLE LAND REMAINING AFTER GROWTH

- Initial Run Scenario vs. Existing 2003

Fresno Co.	"Developable" Land Area	% Change
Existing	70,200	
Initial Run	7,060	-90%

Madera Co.	"Developable" Land Area	% Change
Existing	32,200	
Initial Run	4,100	-87%



Note: "Developable" Land is vacant, rural residential, agriculture, and open space with urban General Plan Designations.

FIGURE 5-6
ACRES OF AGRICULTURAL LAND REMAINING

- Initial Run Scenario vs. Existing 2003

	2003 Acres	2034 Acres	% Change
Fresno County	288.600	255,500	
Madera County	393,400	378,500	
Total Study Area	682,000	634,000	-7.0%

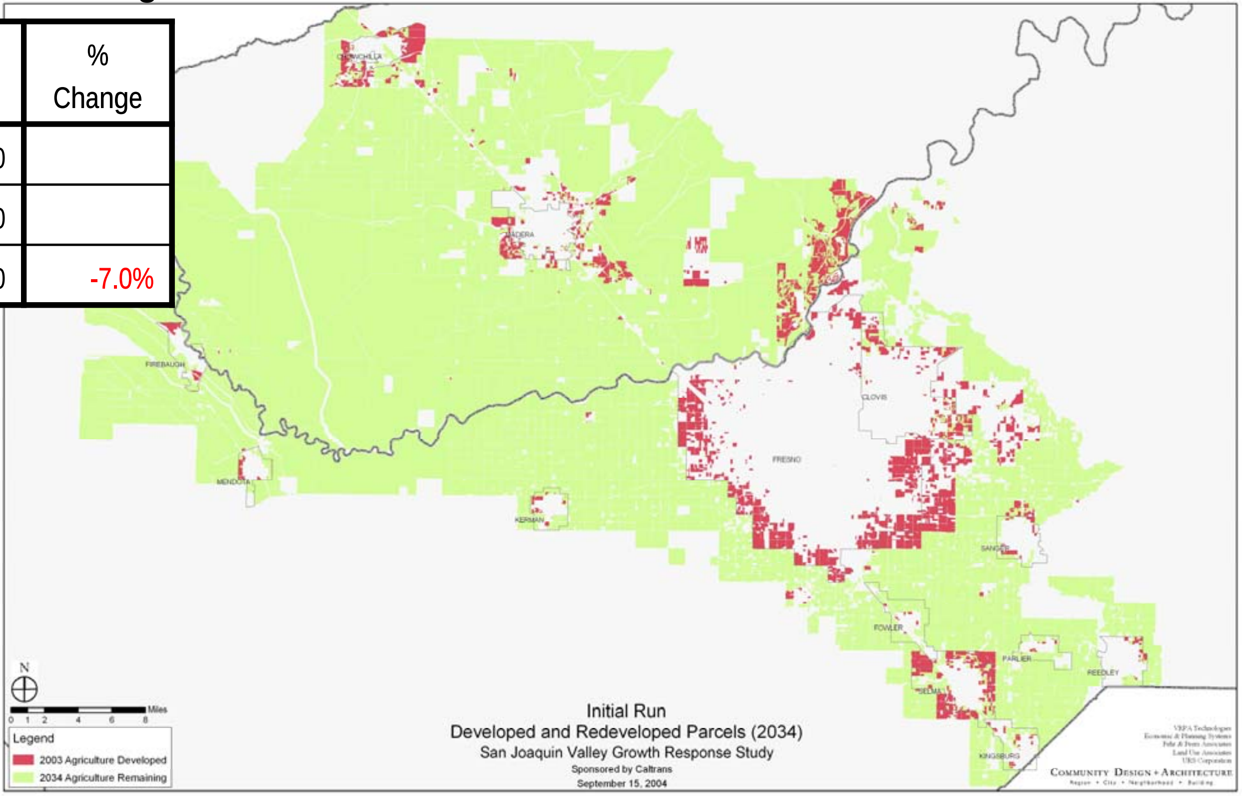


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FIGURE 5-7
DEVELOPMENT FOOTPRINT - 2003 EXISTING CONDITIONS

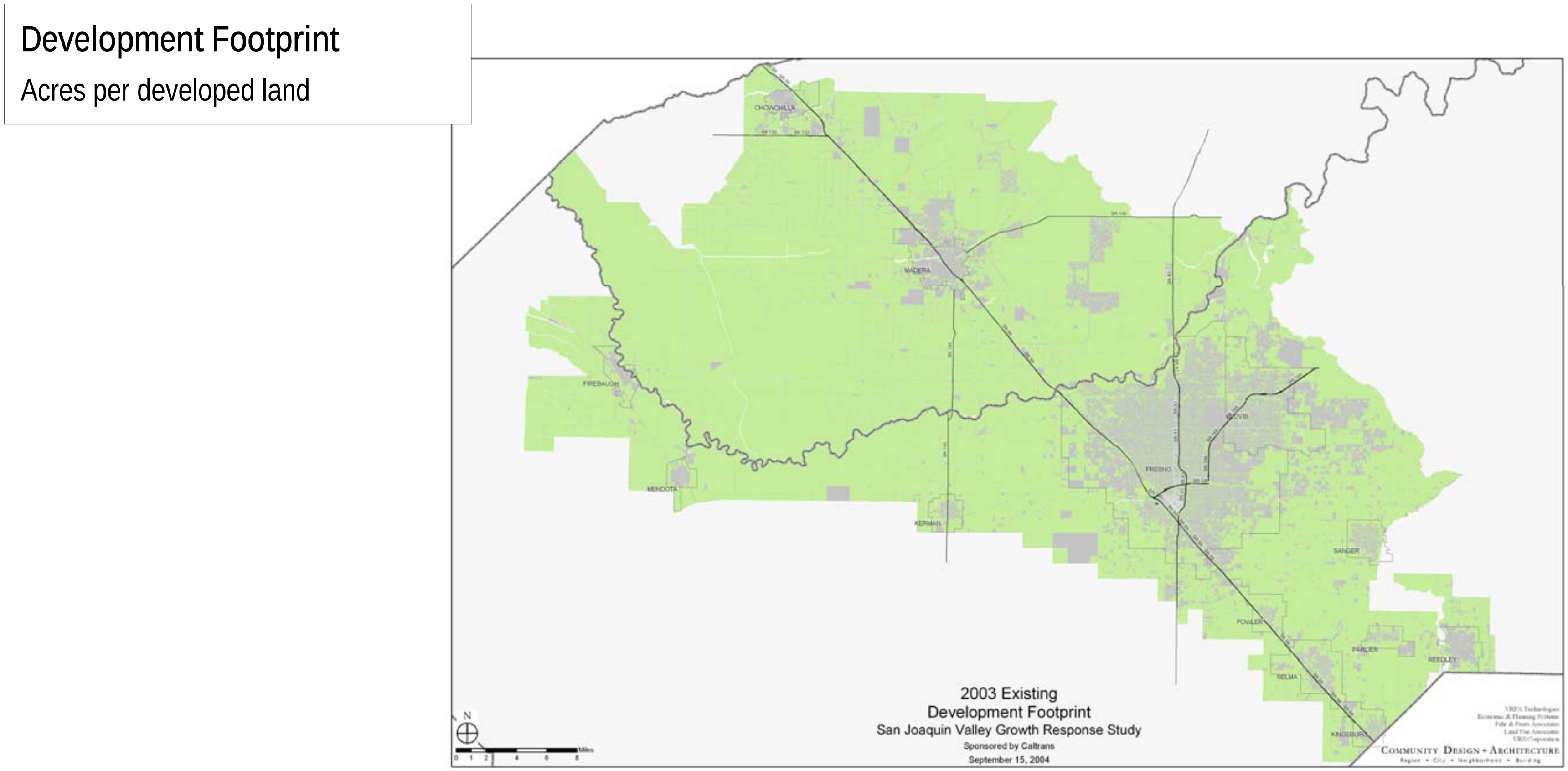

FIGURE 5-8
DEVELOPMENT FOOTPRINT
INITIAL RUN VS 2003

- Initial Run Scenario vs. Existing 2003

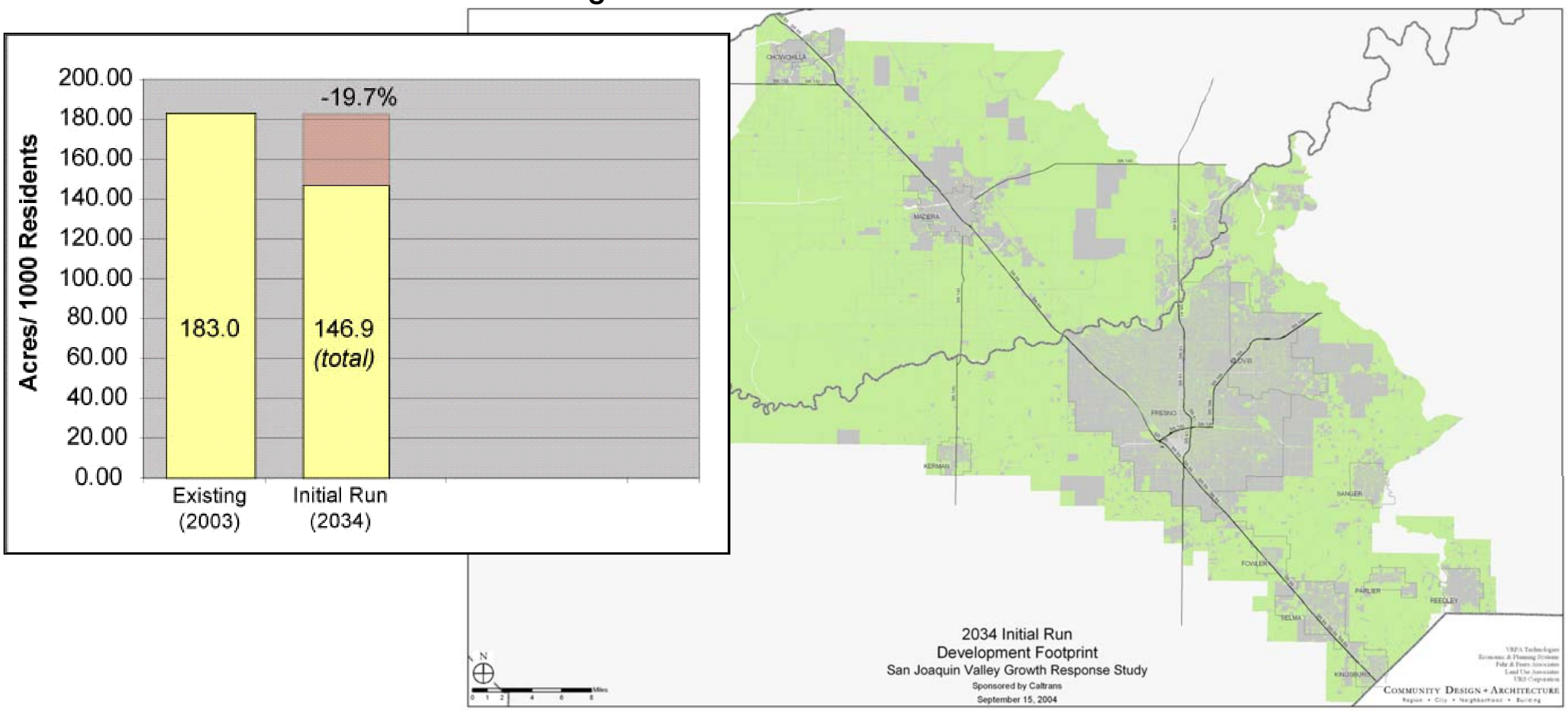

FIGURE 5-9
2003 POPULATION DENSITY

- **Population and Employment Density**
  - Population Density - population per gross developed acre of residential development
  - Employment Density - employees per gross acre of employment use

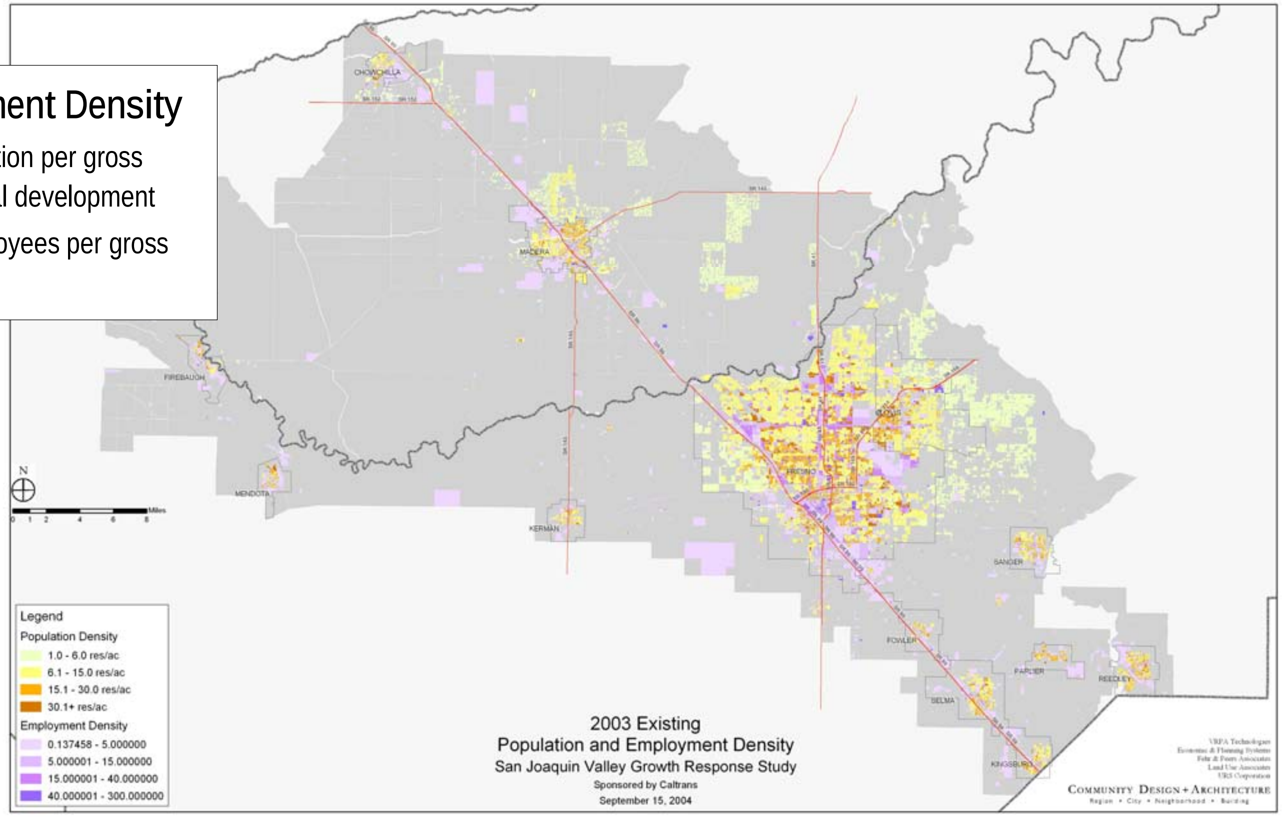

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FIGURE 5-10
POPULATION DENSITY
INITIAL RUN VS 2003

Initial Run vs. Existing 2003

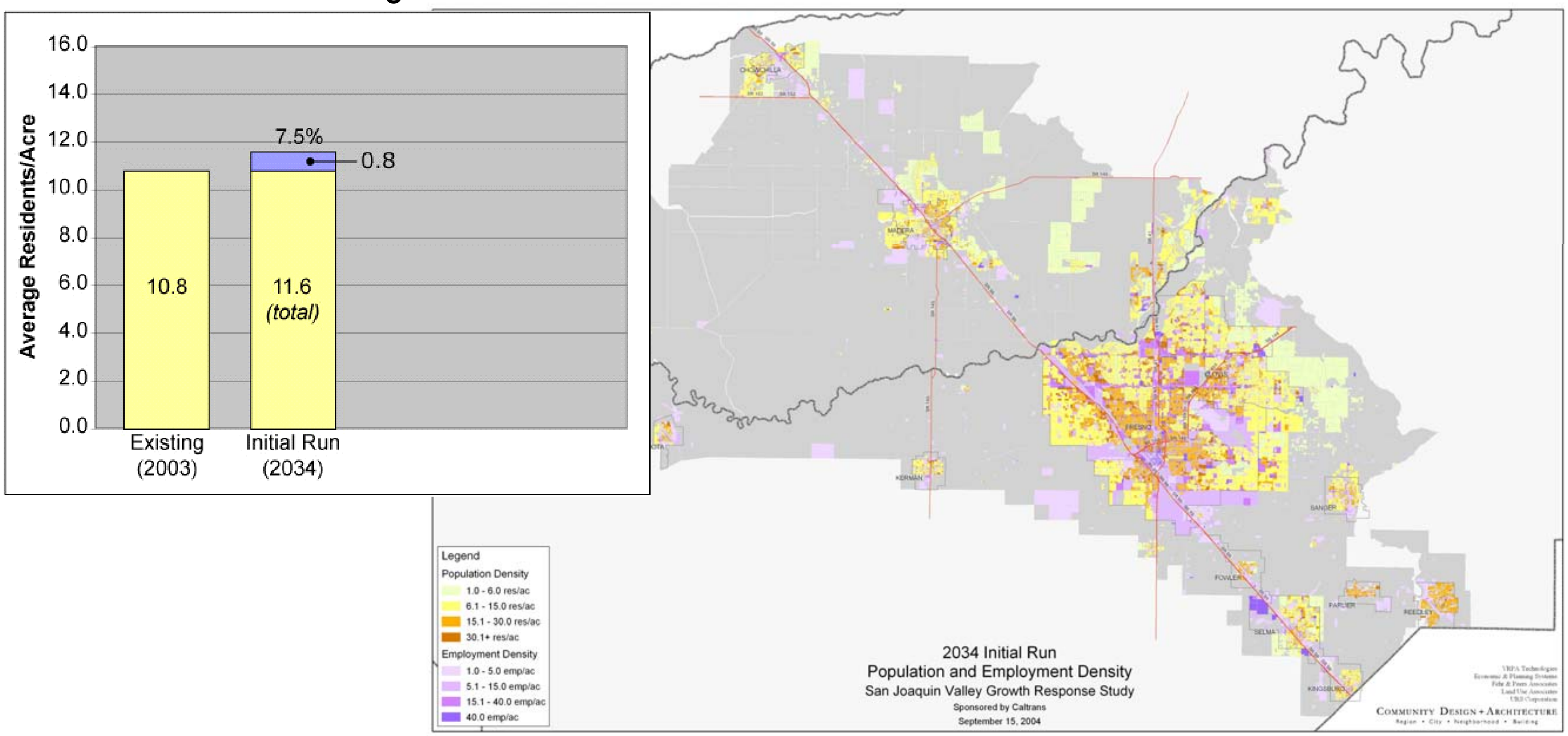

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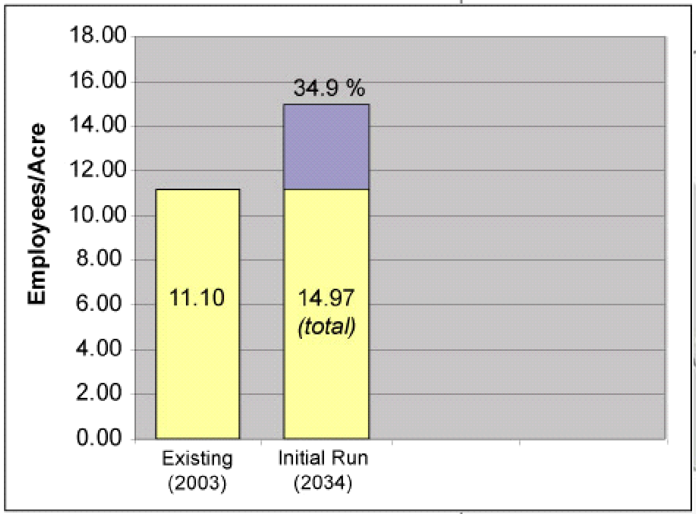
FIGURE 5-11
EMPLOYMENT DENSITY
INITIAL RUN VS 2003

■ Initial Run vs. Existing 2003



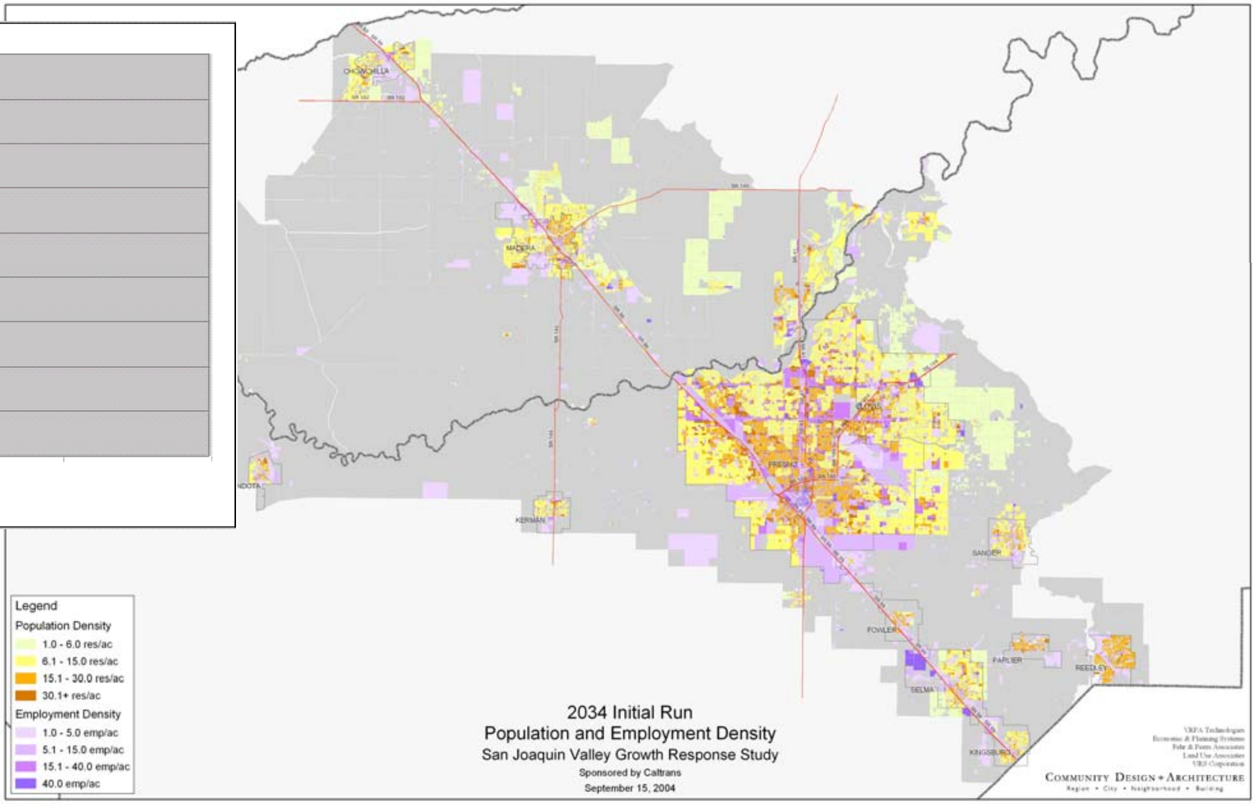


FIGURE 5-12
USE MIX
2003 EXISTING

- **Use Mix**
  - Mix of land uses within a 1/4-mile grid

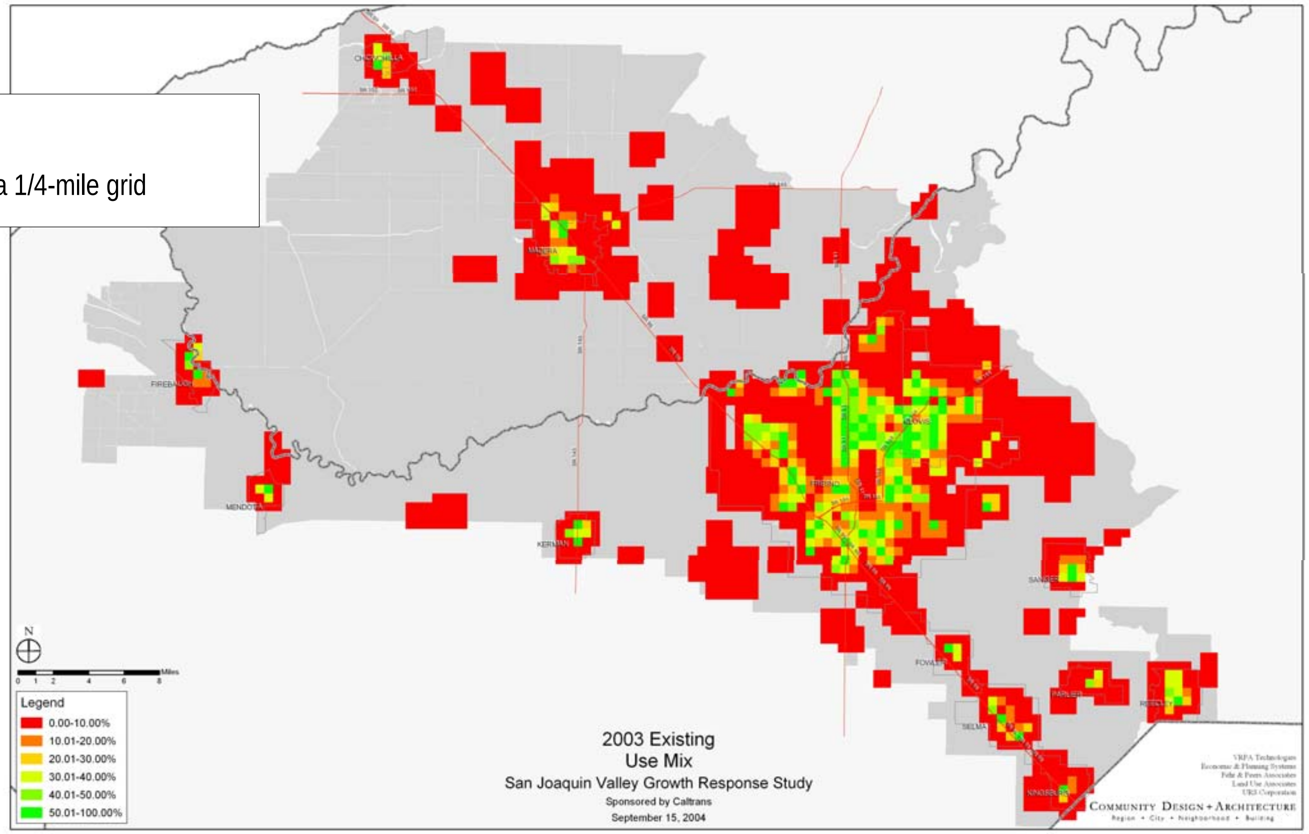
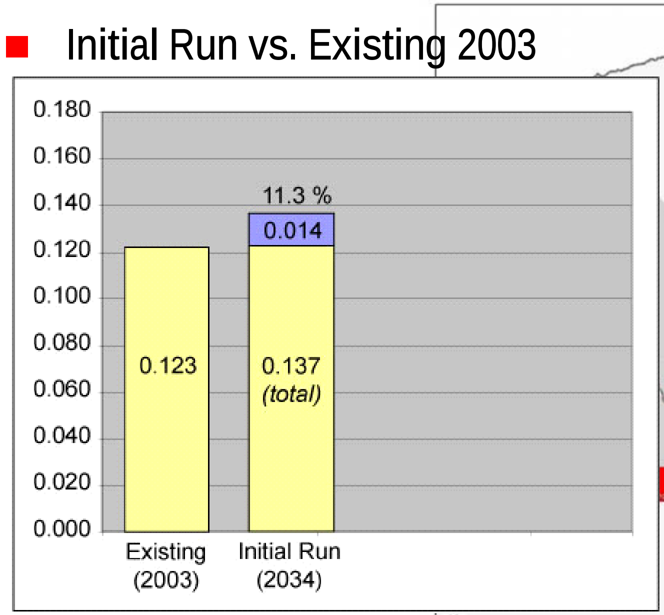


FIGURE 5-13
USE MIX
INITIAL RUN VS 2003 EXISTING



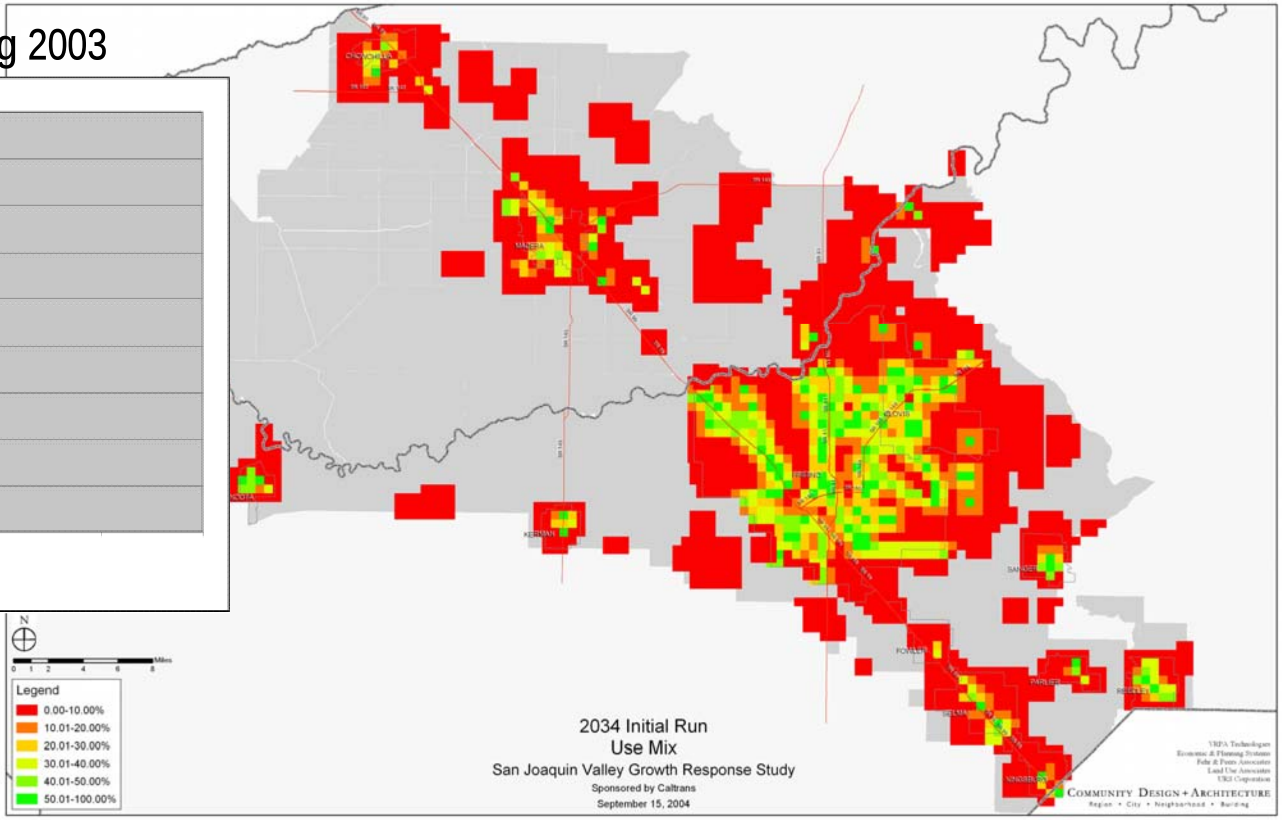


FIGURE 5-14
RESIDENTIAL ADJACENCY TO TRANSIT
2003 EXISTING

- **Housing & Employment Adjacency to Transit**
  - Percent of households and jobs within 1/4 mile of a transit line

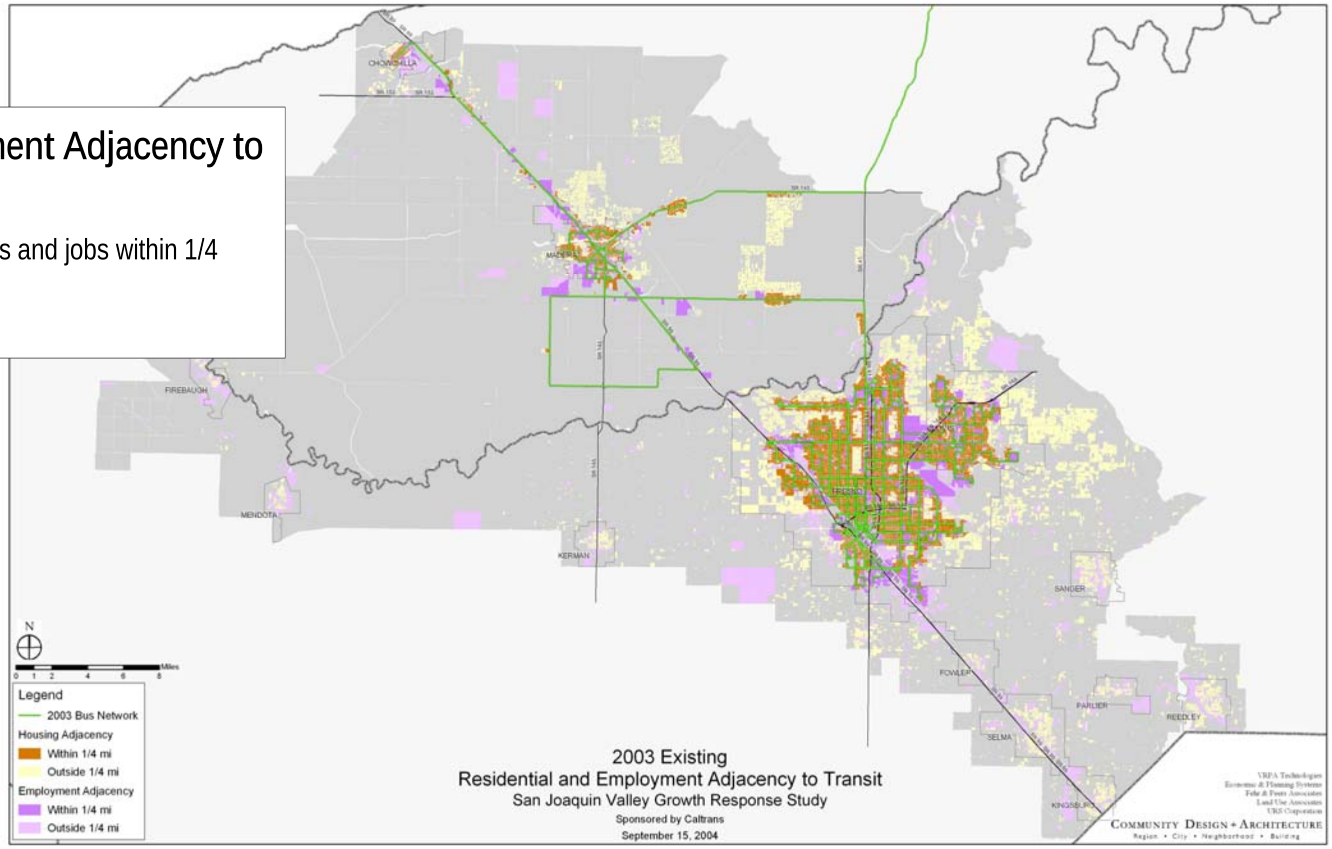


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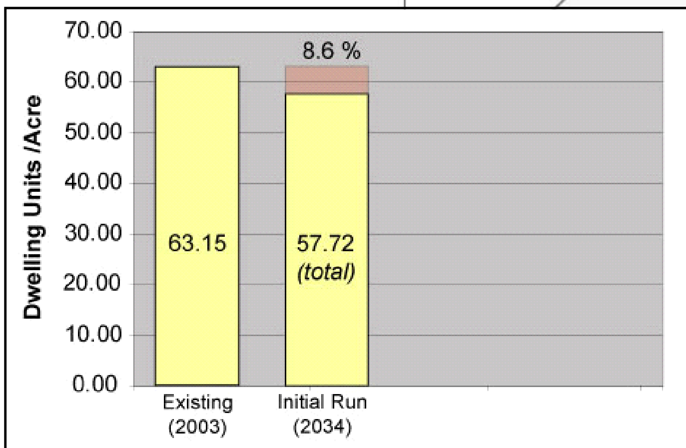
FIGURE 5-15
RESIDENTIAL ADJACENCY TO TRANSIT
INITIAL RUN VS 2003 EXISTING

- Initial Run vs. Existing 2003



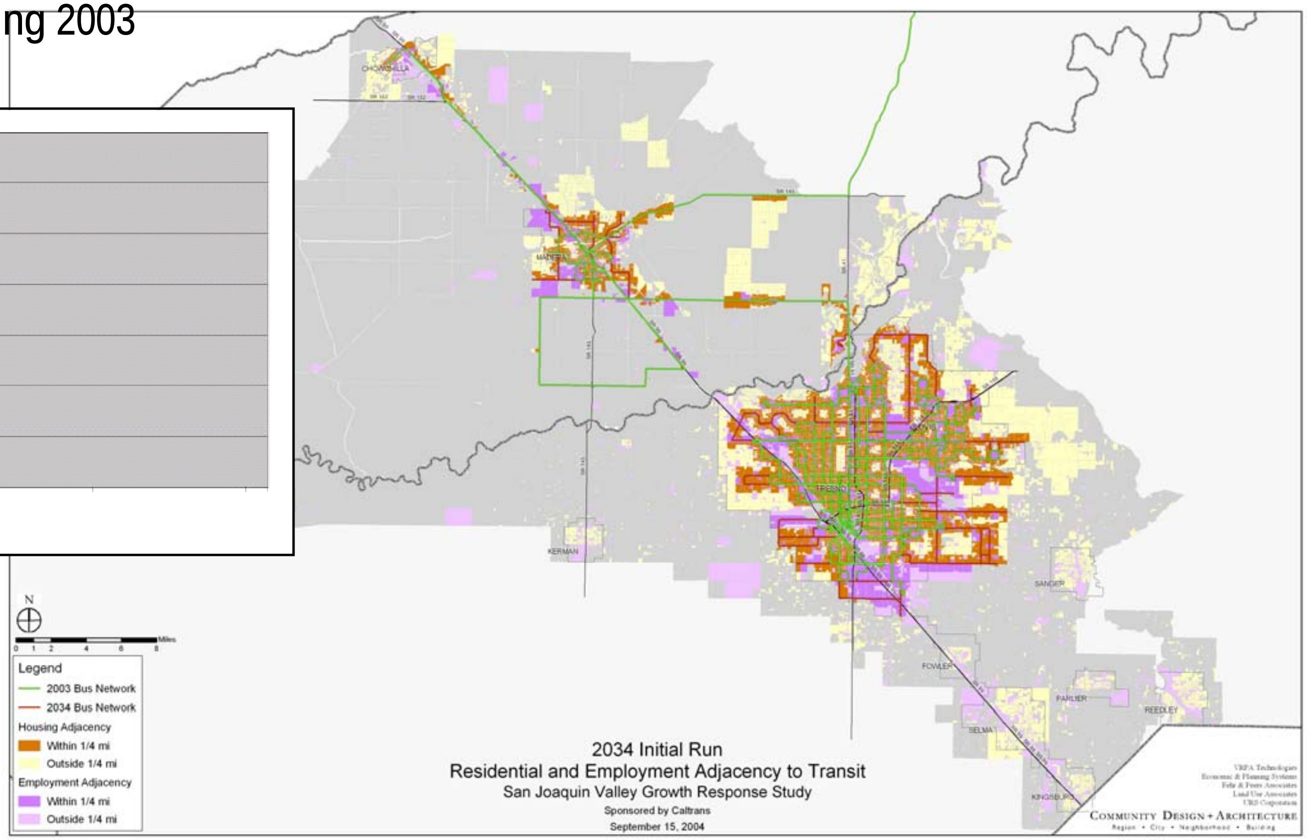
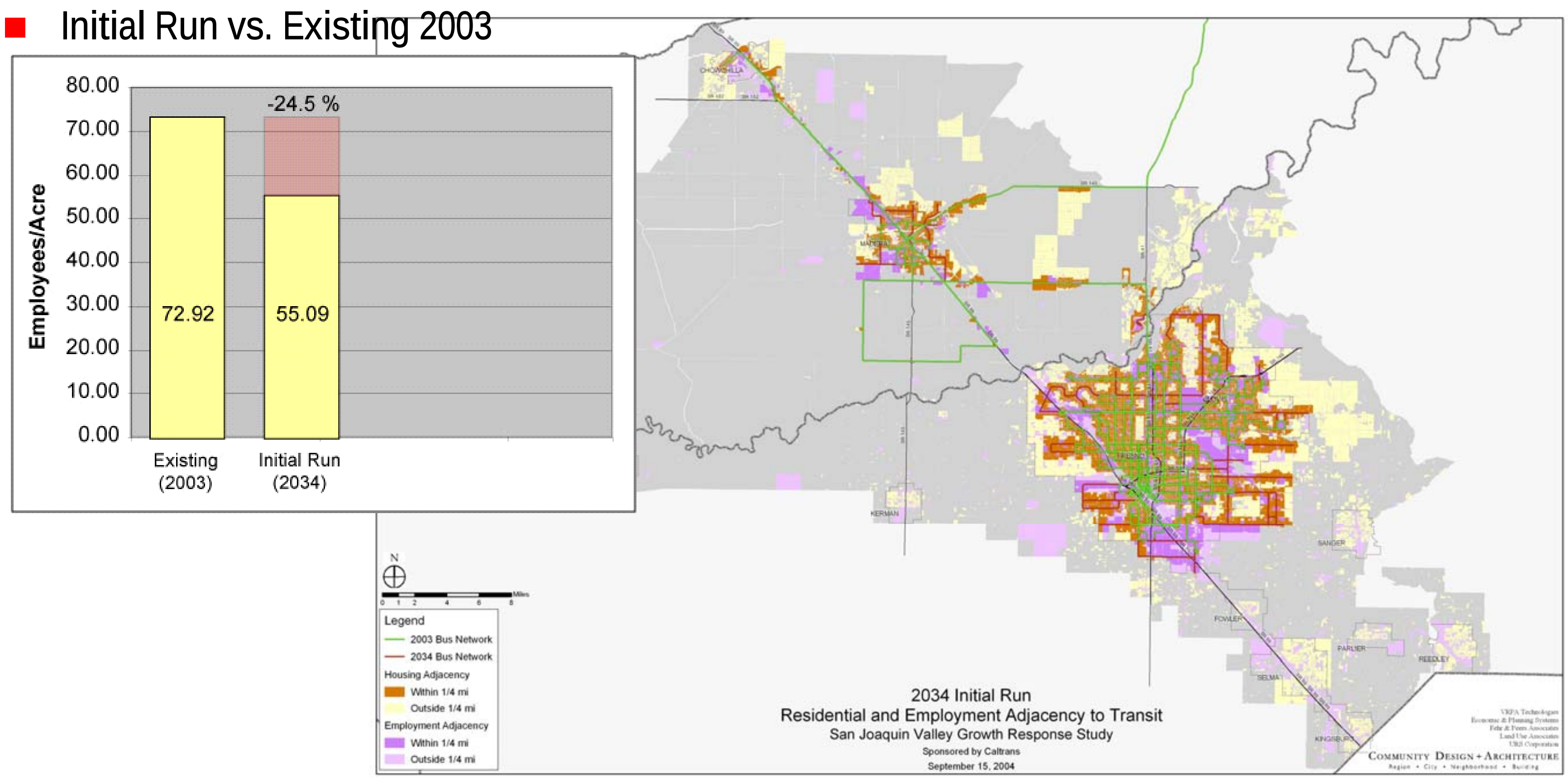


FIGURE 5-16
EMPLOYMENT ADJACENCY TO TRANSIT
INITIAL RUN VS 2003 EXISTING



Key Modeling Data and Assumptions

Model updates
The base year for the Fresno County model (i.e. the year used to calibrate and validate the model) was 1998; the base year for the Madera County model was 2000. The Study Team worked with staff at the Fresno COG, MCTC and Caltrans District 6 to update each model to a common base year representing 2003.

As received in September 2003, both the Fresno and Madera County models' networks and land uses had horizon (i.e., most distant forecast) years of 2025. The horizon year for the Phase III Study was 2034. The land use for 2034 was calculated using What If?. In recognition of fiscal constraints, the 2034 highway networks were not significantly augmented compared to the 2025 networks, except to provide access for all development, and to extend transit coverage, as described in the next section.

2034 Transit Network Assumptions
For the Initial Run basic (conventional) bus service is extended to the Year 2034 urban edge. Basic headways are 30 minutes off-peak and 15 minutes peak for FAX and Clovis routes. Running speeds are 2/3 that of street traffic in the model. This represents roughly a doubling in current transit service in terms of revenue bus miles.

Transportation Modeling Results

This section summarizes the results of the transportation modeling process and compare the existing (2003) versus future (2034) in terms of the following key indicators:

- Vehicle Trips
- Vehicle Miles Traveled (VMT)
- Vehicle Hours Traveled (VHT)
- Average Roadway Speeds
- Transit Ridership

These indicators were separately summed for Fresno and Madera Counties, as well as for the detailed What If? Study Areas of these counties.

Comparison of the Initial Run to 2003 Existing Conditions

Baseline 2003 conditions are shown in Table 5-3. The Initial Run 2034 scenario is compared to 2003 conditions in Tables 5-4 through 5-8 and corresponding Figures 5-17 through 5-21. The transportation forecast indicates that by most measures, traffic levels will approximately double in the Study Area by the year 2034 over 2003 levels.

TABLE 5-3
TRANSPORTATION INDICATORS BASED ON 2003 TP+ MODELS

		Vehicle Trips	VMT	Speed (mph)	VHT
Fresno COG Model	Fresno County[1]	2,451,465	20,076,000	42	479,748
	Fresno County What If? Study Area	2,190,590	13,708,600	39	351,165
Madera County Model	Madera County	488,543	3,446,450	42	81,608
	Madera County What If? Study Area	395,975	2,497,010	43	58,147

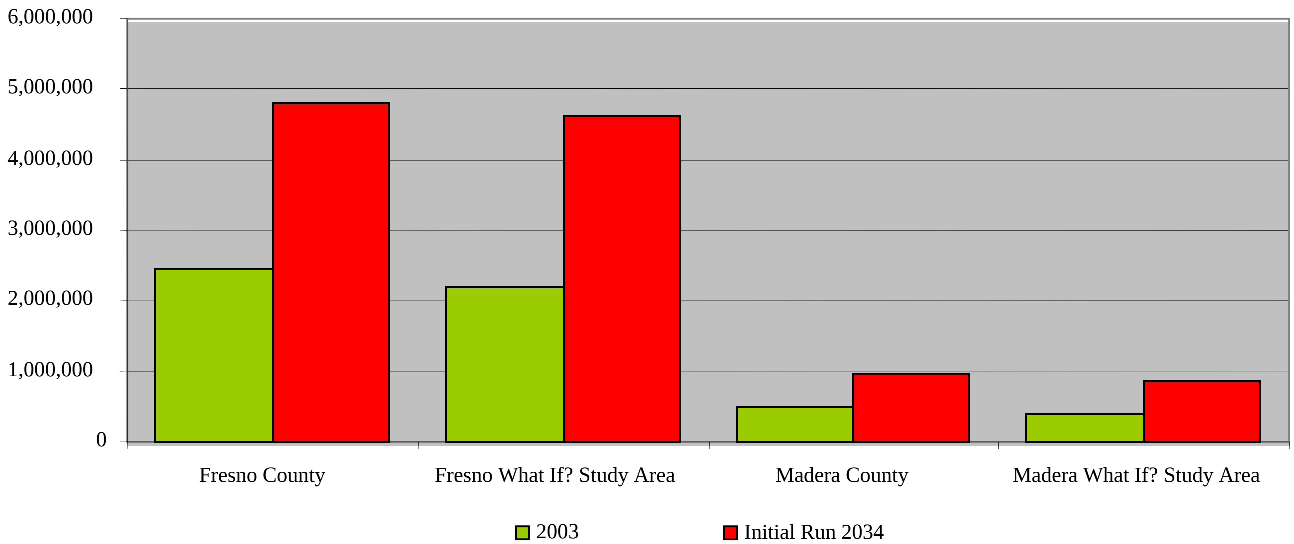
Key: VMT=Vehicle Miles Traveled; VHT=Vehicle Hours Traveled; mph=Miles per hour

As indicated in Table 5-4 and corresponding Figure 5-17, Fresno County will see a near doubling in vehicle trips, while Madera County will see more than a doubling of vehicle trips. The detailed modeling subareas of each county (i.e. the “urban core” area that was the focus the What If? Land use modeling) will see an even greater percentage increase in vehicle trips than the county as a whole.

TABLE 5-4
DAILY VEHICLE TRIPS

	2003	Initial Run 2034	Percentage Increase
Fresno County	2,451,465	4,788,239	95%
Fresno County What If? Study Area	2,190,590	4,623,400	111%
Madera County	488,543	968,274	98%
Madera County What If? Study Area	395,975	859,515	117%

FIGURE 5-17
DAILY VEHICLE TRIPS



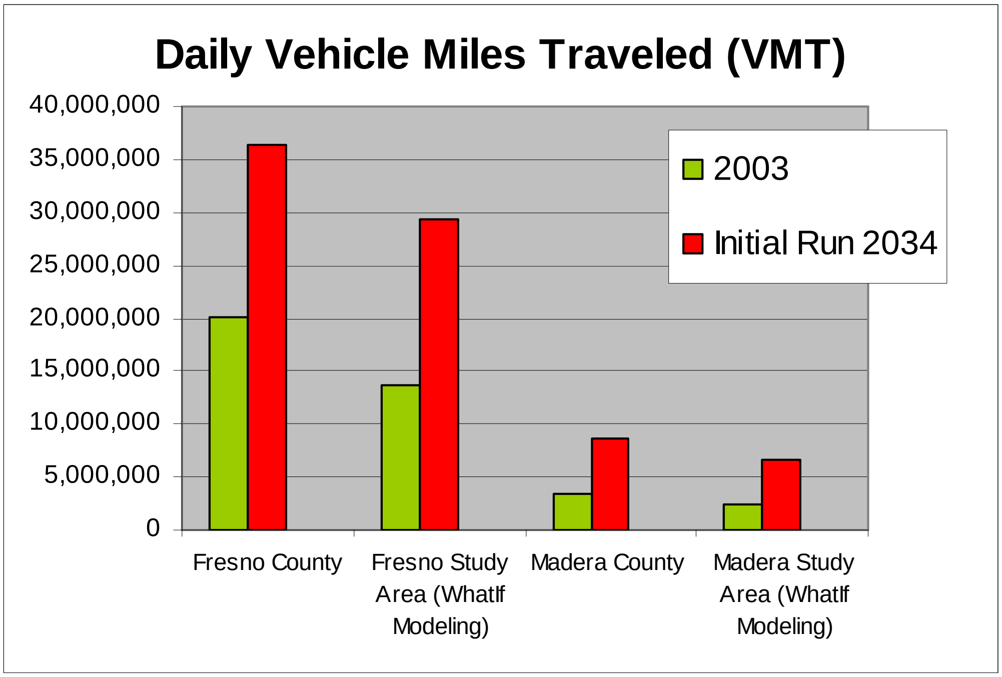
The data in Table 5-5 and corresponding Figure 5-18 show similar results for Vehicle Miles Traveled (VMT) as was seen for Vehicle Trips. Fresno County will see a near doubling in VMT, while Madera County will see an increase in VMT to two and one-half times current levels. Again, the detailed modeling subareas of each county (the locus of most future development) will see an even greater percentage increase in VMT than the county as a whole.

TABLE 5-5
DAILY VEHICLE MILES TRAVELED

	2003	Initial Run 2034	Percentage Increase
Fresno County	20,076,000	36,462,235	82%
Fresno County What If? Study Area	13,708,600	29,420,756	115%
Madera County	3,446,450	8,677,118	152%
Madera County What If? Study Area	2,497,010	6,546,114	162%

Key: VMT=Vehicle Miles Traveled

FIGURE 5-18



Data in Table 5-6 and corresponding Figure 5-19 show that for all four geographic areas, increases in Vehicle Hours Traveled (VHT) are even more extreme, since this measure captures the cumulative effects of additional trip making, longer trips, and more hours of congestion. Fresno County will see more than a doubling in VHT, while Madera County will see an increase in VHT to three and one-half times current levels. Again, the detailed modeling subareas of each county (the locus of most future development) will see an even greater percentage increase in VHT than the county as a whole.

TABLE 5-6
DAILY VEHICLE HOURS TRAVELED

	2003	Initial Run 2034	Percentage Increase
Fresno County	479,748	1,115,243	132%
Fresno County What If? Study Area	351,165	889,193	153%
Madera County	81,608	292,121	258%
Madera County What If? Study Area	58,147	227,944	292%

FIGURE 5-19

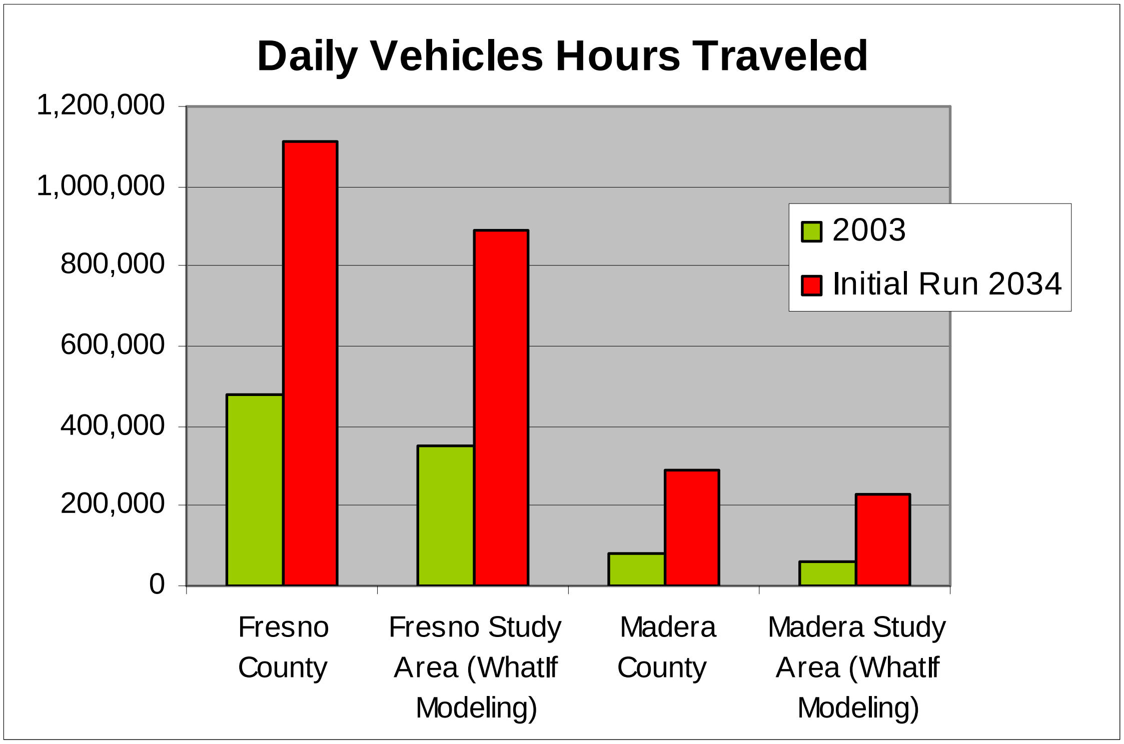


Table 5-7 and Figure 5-20 summarize modeled roadway speeds in the Study Area. Both counties will see significant declines. Madera County will see a relatively greater decline as it becomes increasingly urbanized and experiences both lower speed limits and increased delays due traffic controls and congestion (particularly in the vicinity of the SR 41 San Joaquin River Bridge).

TABLE 5-7
DAILY AVERAGE SPEED (MILES PER HOUR)

	2003	Initial Run 2034	Percentage Change	Speed Change (Miles per Hour)
Fresno County	42	33	-21%	-9
Fresno County What If? Study Area	39	33	-15%	-6
Madera County	42	30	-29%	-12
Madera County What If? Study Area	43	29	-33%	-14

FIGURE 5-20
DAILY AVERAGE SPEED (MILES PER HOUR)

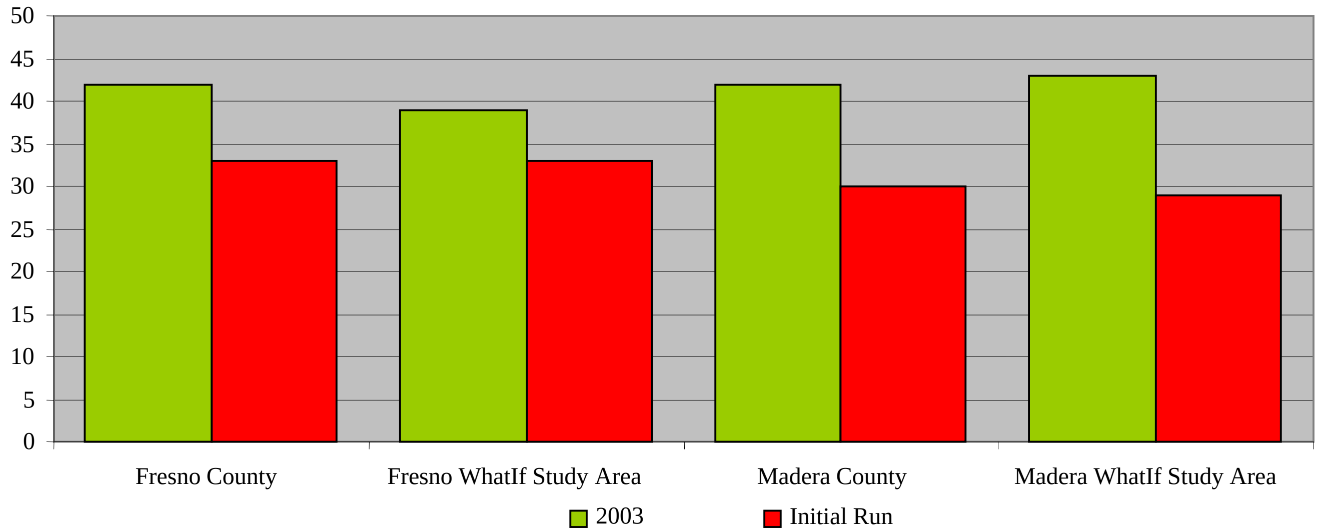
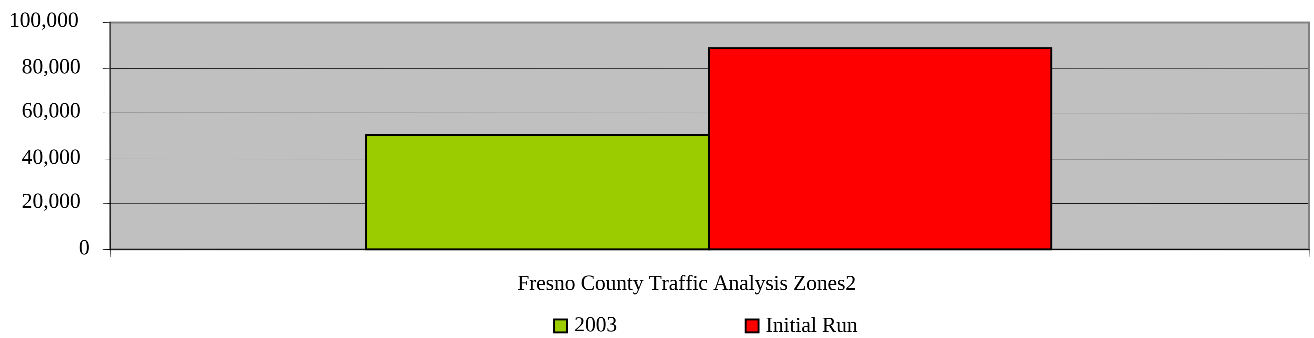


Table 5-8 and Figure 5-21 show comparative transit ridership predicted by the Fresno County model for 2003 and the 2034 Initial Run. Transit ridership increases by a substantial amount (76 percent), roughly proportionate to the increase in bus service miles over 2003. This is, however, less than the rate of Vehicle Trip growth in Fresno County (82 percent) implying a reduction in transit's share of all trips.

TABLE 5-8
TOTAL DAILY TRANSIT – PERSON TRIPS

	2003	Initial Run 2034	Percentage Increase
Fresno County Traffic Analysis Zones[2]	50,331	88,425	76%

FIGURE 5-21
TOTAL DAILY TRANSIT TRIPS (PERSON TRIPS)



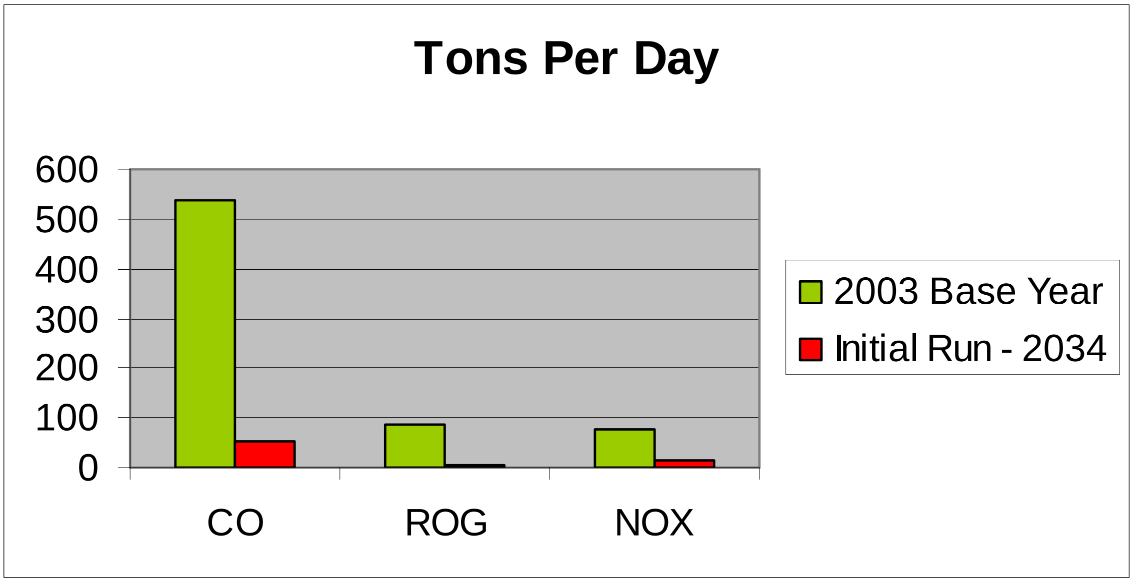
Other Analysis

In addition to the indicators described in the previous sections of this Chapter, an analysis of air quality impacts was developed by the Study Team. Table 5-9 and Figure 5-22 provide a comparison of the existing conditions (2003) to the Initial Run Scenario.

TABLE 5-9
AIR QUALITY INDICATORS

Scenario	POP	VMT	Tons/Day			Lbs/Yr/Capita			Lbs/VMT		
			CO	ROG	NOX	CO	ROG	NOX	CO	ROG	NOX
2003 Base Year											
Fresno	855,743	20,076,000	489.8	79.6	67.8	417.9	67.9	57.8	0.0488	0.0079	0.0067
Madera	117,606	3,446,450	49.7	4.8	8.9	308.7	29.7	54.9	0.0289	0.0028	0.0051
TOTAL	**973,349**	**23,522,450**	**539.6**	**84.4**	**76.6**	**726.6**	**97.6**	**112.7**	**0.0777**	**0.0107**	**0.0119**
Initial Run - 2034											
Fresno	1,420,432	36,462,235	39.9	5.3	8.8	20.5	2.7	4.5	0.0022	0.0003	0.0005
Madera	306,380	8,677,118	11.2	1.4	3.7	26.8	3.4	8.9	0.0026	0.0003	0.0009
TOTAL	**1,726,812**	**45,139,353**	**51.1**	**6.8**	**12.6**	**47.3**	**6.2**	**13.4**	**0.0048**	**0.0006**	**0.0013**

FIGURE 5-22
AIR QUALITY IMPACTS
2003 VS INITIAL RUN



CHAPTER 6 – DEVELOPING THE ALTERNATIVE SCENARIOS

The Phase III Study Team has prepared a framework of candidate transit corridors and intensification areas for the Stakeholders Group and others to use as a starting point for framing the alternative scenarios that will be developed using the Phase III land use and transportation planning tools (What if?, INDEX, TP+, and 4-D Assessments). The purpose of the alternative scenarios process is to continue to show the Stakeholders Group and the broader Study Area the utility of the Phase III tools for future policy planning efforts in the Study Area. While the scenarios that are defined may provide a "side-benefit" to communities in the Study Area to begin testing concepts in relation to on-going planning efforts, the major focus of the Phase III effort is to develop these tools for the Study Area so that communities can use these tools as they undertake planning in the Study Area.

Alternative Scenarios Framework

The Phase III Study Team used the information gathered in the 3rd Stakeholders Group Workshop as a starting point for preparing the Framework. The concept of the framework is to identify the most likely transit corridors and areas within the "core" of the Study Area that have the most potential for intensification or revitalization of land use in a mixed-use, pedestrian-friendly manner. Specifically, the GRS Study will develop two alternative scenarios that:

1. Use different combinations of these corridors and opportunity areas;
2. Create different intensities or mixes of uses in the opportunity areas that are utilized in a scenario, based on policy goals, market realities, or other factors;
3. Plan for different types of transit in different corridors; and,

4. Can consider different intensities of use in the areas outside of the identified opportunity areas.

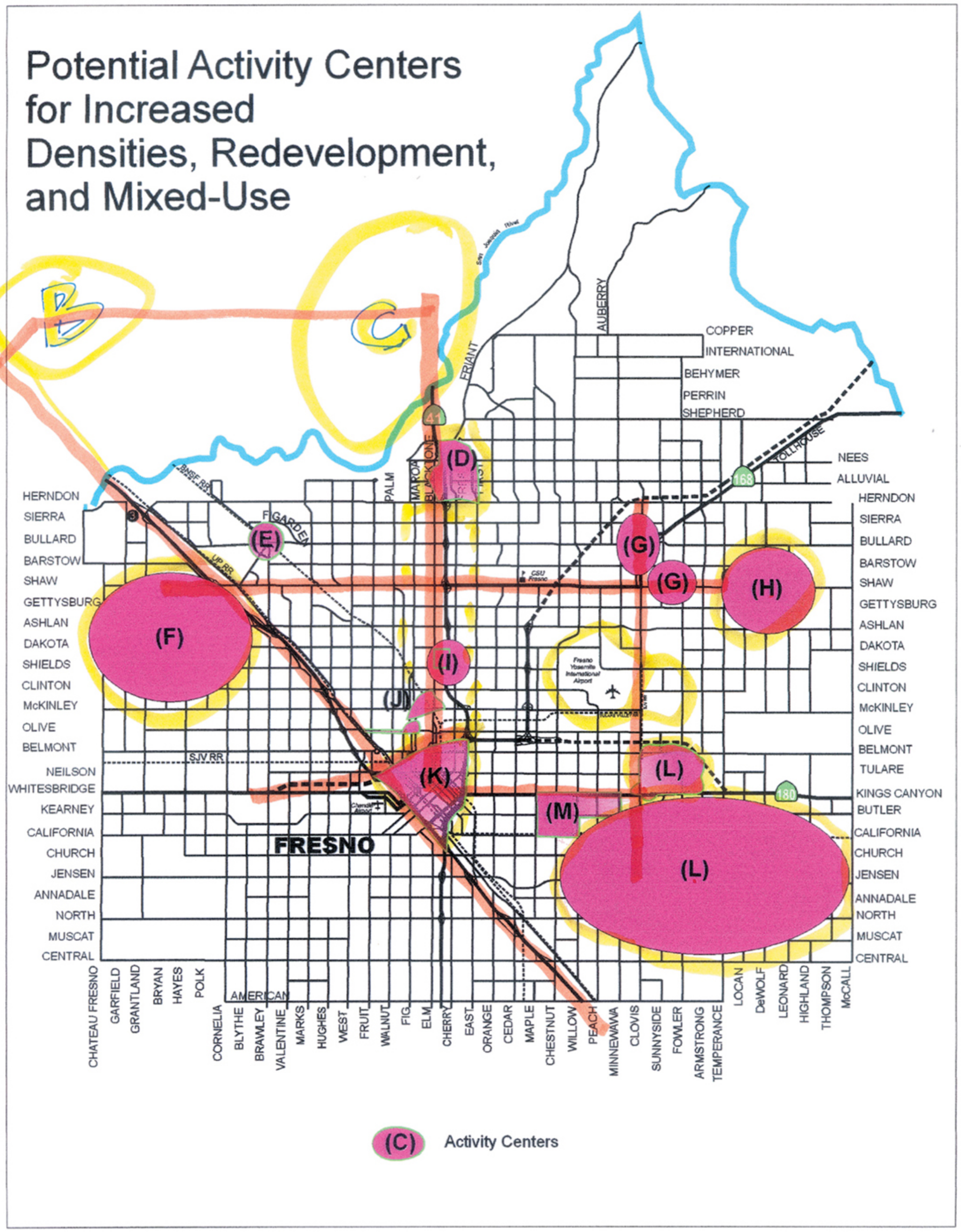
Two types of opportunity areas have been identified – New Growth Intensification Areas and Infill/Revitalization Areas. Figure 6-1 depicts the opportunity areas.

New Growth Intensification Areas

New Growth Intensification Areas are places that are mainly undeveloped today, that have a high-potential for future growth, and that have opportunities for intensification and mixes of use beyond what has been planned or discussed to date. These areas have been identified as:

- **Madera Community College:** a portion of the planned development adjacent to Madera Community College along Avenue 12.
- **Southeast Madera County New Town Center:** the town center of the planned communities of Village of Gateway and Rio Mesa at the intersection of Avenue 12 and Highway 41 in Madera County.
- **Gunner Ranch West Town Center:** a portion of the planned business park and retail development around Children's Hospital west of Highway 41 in Madera County.
- **Copper River:** the southeast corner of this planned community in Fresno adjacent to a potential transit corridor on Willow Avenue.
- **Clovis Northwest Urban Center:** a portion of the Clovis' Northwest Urban Center adjacent to the potential transit corridor on Willow Avenue.
- **West Shaw:** the undeveloped area within a 1/2 mile of Shaw Avenue in Fresno to the west of Highway 99.

FIGURE 6-1
OPPORTUNITY AREAS



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- **Clovis Southeast Urban Center:** the town center and surrounding residential neighborhoods within 1/2 mile of Shaw in this planned urban center in Clovis.

- **Whitesbridge:** the mostly undeveloped area within 1/2 mile of Whitesbridge mainly to the west of the Chandler Airport.

- **Southeast Fresno:** the mainly undeveloped area within 1/2 mile of Kings Canyon Road from approximately Temperance Avenue to DeWolf Avenues.

- **Fancher Creek:** this area is a combination of a New Growth Area and Infill/Revitalization Area mainly to the north of Kings Canyon Road from Clovis Avenue to just east of Fowler Avenue.

Infill/Revitalization Areas

Infill/Revitalization Areas are places that are currently developed but that have potential for future infill development and revitalization or reuse with a mix of more intensive land uses. The identification of these areas within the alternative scenarios will need to take consideration of the likelihood of properties to revitalize by 2034; this will be done at a fairly general level in the Phase III Study, given that the Study is illustrative and not a policy planning study. These areas were identified as:

- **Blackstone Corridor:** the Blackstone Avenue portion of the Mid-rise/High-rise Corridor identified in the City of Fresno General Plan. This includes the mainly commercial properties fronting onto the west side of Blackstone from Divisadero Street to Herndon Avenue. On the eastside of Blackstone it includes all of the properties between Blackstone and Highway 41 from Herndon Avenue south to Shields Avenue. From Shields to McKinley Avenue it includes the commercial properties fronting onto Blackstone. South of McKinley it includes the mainly commercial and employment area from Blackstone to Dry Creek Canal and roughly south along the BNSF railroad right-of-way to Highway 180. From 180 to Divisadero the area includes the commercial properties fronting onto Abby and the blocks between Abby and Blackstone.

- **Clovis Shaw Corridor:** this area includes the mainly commercial and vacant properties fronting onto Shaw from Highway 168 to the Sierra Vista Mall.

- **Fresno Yosemite International Airport:** a grouping of properties to the west and east of the Clovis Avenue transit corridor; these are a combination of vacant and developed parcels.

- **Kings Canyon & Willow:** a cluster of vacant infill sites and revitalization sites in the area of the intersection of Kings Canyon Road and Willow Avenue.

- **Downtown Fresno:** the downtown of Fresno within the triangle of Highways 99, 180, and 41 with the exception of the mostly residential area to the north of Divisadero Street.

Transit Corridors

A series of transit corridors were also selected that could create a comprehensive transit network within the core of the Study Area. In the development of the alternative scenarios the type of transit service in the corridors can vary and not all of the corridors need to be used in the scenarios. The potential transit corridors include:

- **Avenue 12** from Highway 99 to Highway 41.

- **Highway 99 Rail Corridor** from the northern boundary of Madera County to the southern boundary of Fresno County. This is the only transit-type specific corridor with the service likely being commuter rail connecting a variety of cities in the greater San Joaquin Valley. It is also a potential High-Speed Rail corridor.

- **Blackstone/41** from Avenue 12 to Downtown Fresno.

- **Shaw Avenue** from about Grantland Avenue to center of the Clovis Southeast Urban Center.

- **Clovis Avenue** from Kings Canyon to Downtown Clovis where the corridor could split and utilize rail corridors to reach the Northeast Urban Center and to Willow Avenue and north to Copper Avenue.

- **Kings Canyon Road and Ventura Avenue** from Downtown Fresno to the center of the South East Fresno opportunity area.

- **Whitesbridge Avenue** from Brawley Avenue to A and B Streets and into Downtown Fresno.

As previously mentioned, the framework was used to create the two alternative scenarios to be studied by choosing and deciding on the potential land uses within the opportunity sites, identifying the transit corridors to use and the types of transit that would use the corridors, and how to treat the remaining areas outside of the opportunity sites.

For example, a more intensive scenario might include maximizing intensity of development within Downtown Fresno, the Blackstone Corridor, and in the new town centers in Madera County and running a higher-investment transit system down Blackstone and Highway 41, such as light rail or monorail, to serve this new development. The Kings Canyon, Clovis, and Shaw Corridors might include bus rapid transit with more medium-intensity development in the opportunity areas along these corridors. The remaining general plan areas outside of the opportunity sites might include a moderate increase in average density of about 20 to 33 percent, for example low density residential development might average 6 units to the acre rather than the 4.5 units per acre used in the Initial Run Scenario.

Another scenario could take a more market-based approach to the build-out of the opportunity sites. Starting with consideration of the extent of intensification and mix of use that might be expected in opportunity sites and then identifying the transit types that would best serve these, likely ranging from Bus Rapid Transit (BRT) to express bus and flexible route on-call transit service. Under this more market-based scenario, average densities outside of the opportunity would remain closer to the current average.

During Workshop #3, the Study Team had three main goals:

- To update the Stakeholders on the progress of the Study since the 2nd Workshop,
- To present the Initial Run scenario, and
- To solicit input on alternative land use and transportation scenarios using interactive polling or “clicker” technology.

Interactive polling technology was used to solicit input on alternative land use and transportation scenarios. More detail regarding this process is provided in Appendix D. Following Workshop #3, the generalized Intensification Areas OR opportunity areas (reference Figure 6-1) were refined to a specific geographic boundary at the parcel level. The prioritization of the Intensification Areas resulted in a number of previously separate Intensification Areas being combined, due to their close proximity and/or relative importance. Grouping the Intensification Areas allowed many of the more minor areas to be captured in the analysis. Potential transit corridors were also identified that complemented the location of the Intensification Areas in order to provide a framework that would connect land use intensification with significant transit service. This framework was then refined to two Alternative Scenarios to analyze as a contrast to the Initial Run Scenario.

Both Alternative 1: Blackstone and Downtown Fresno Focus Scenario and Alternative 2: BRT Network Scenario drafts and their order of magnitude growth projections were then reviewed with the Cities of Fresno and Clovis, since the Intensification Areas were largely concentrated within these jurisdictions. Based on this feedback, the two Alternatives were finalized for the model runs.

The Alternatives were processed to determine the amount and type of land use capacity within the Intensification Areas, and then the amount and type of growth that the Intensification Areas would absorb. The Study Team developed detailed land capacity tables at the parcel level in order to determine the amount and type of growth that would be located within the Intensification Areas based on market demand and preferences for these pedestrian-friendly and more transit-focused areas. With the 4-D Model, density, diversity, design and destination were considered in this process.

On the whole, densities were increased within their defined ranges for each of the land uses within the Intensification Areas, particularly in the City of Fresno's downtown and Midrise/Highrise corridor. Land use categories were also added to diversify and account for even higher densities than the maximum ranges defined for the base land uses. Two new land use categories were added to the base list, "Very High Density Residential" and "Mixed-Use." The mix of multi-family residential, office, and commercial uses within the Mixed-Use designated areas were carefully considered to determine the location of the particular Intensification Area. That is, percentages of office, high-density residential, and retail were defined and calculated specifically for each of the Intensification Areas. Also considered was the mix of uses. That is, some Intensification Areas were defined as containing only office and retail, while others contained all three types of uses, office, residential and retail. This Intensification Area definition was performed as an iterative process.

In conjunction with this process, the Study Team refined the new and expanded transit service to complement this increase in intensification and diversity of use in the Intensification Areas. Under Alternative 1 light rail transit (LRT) runs in the Blackstone and Kings Canyon Corridor. Headways are 10 minutes off-peak and 5 minutes peak. Running speeds are equal to that of adjacent street traffic. A new local bus line is added on Clovis Avenue between Kings Canyon and Shaw. Basic (conventional) bus service is extended as described above for the Initial Run.

Under Alternative 2, bus rapid transit (BRT) runs in the Blackstone and Kings Canyon Corridor as well as along Shaw Avenue and Clovis Avenue. Headways are 5 minutes off-peak and 2.5 minutes peak. Running speeds are 4/5 that of street traffic. Basic (conventional) bus service is extended as for the other two 2034 scenarios.

Based on feedback gathered from Workshop #3, the two Alternative Scenarios were each defined by a transit system type linking the Intensification Areas along the system. *Alternative 1: Blackstone and Downtown Fresno Focus Scenario* saw greater intensities in land uses to complement the higher speed/higher capacity transit of that scenario. This meant higher densities and a greater mix of land uses surrounding a fixed-guideway transit system serving the Blackstone/41 Corridor, Downtown Fresno, and revitalized and new growth areas to the southeast area of Fresno City. For *Alternative 2: BRT Network Scenario*, growth within the Intensification Areas did not “push” the market to the degree that Alternative 1 would in order to provide a more market “realistic” scenario.

As indicated by the title, this alternative would be served by a Bus Rapid Transit system, which would function more as a network rather than the corridor orientation of Alternative 1. In addition, current local bus service within the City of Fresno metro area was expanded to serve overall new growth. Both scenarios were discussed primarily with FAX in order to solicit feedback regarding transit expansion and enhancement. Both the Intensification Area land uses and new transit services were manually mapped in GIS creating new land use and transit policy maps for these focus areas.

Since the actual allocation of growth to the Intensification Areas occurred outside of the models within a spreadsheet, the total amount of growth by land use type was then deducted from the total projected growth for the Study Area by land use category. For example, the Intensification Areas absorbed approximately 32,000 office jobs in Alternative 1. In running the *What If?* land use allocation model, this number was deducted from the total number of office jobs that would be allocated to the remainder of the Study Area to parcels suitable for office. A similar process was performed for each of the land uses, accounting for overlap in market preferences between similar land uses given the locational and market choices households typically make in determining where to live. A similar approach was taken with employment uses.

Once the amount of growth that would be absorbed by the Intensification Areas was determined for each scenario, the remainder of the projected growth to 2034 was allocated to the Study Area outside the Intensification Areas using the *What If?* model. The Intensification Areas were physically removed from the geographic space so that the model did not process those parcels similar to the removal of the City of Fresno SOI from the Initial Run Scenario allocation.

The What If? Model

The modeling process was similar to the Initial Run. The preparation of the UNION file for the alternatives included the City of Fresno SOI with only the Intensification Areas removed. Because of this, additional effort was needed to convert the City's existing and General Plan land use categories to *What If?* categories since this was not required for the Initial Run. Including verifying that the land use plan had the intended capacity absorb the projected growth.

In addition, the Study Team developed additional growth patterns for each of the Alternatives in order to direct the *What If?* model allocation to priority areas. Figures 6-2 and 6-3 provide a graphic view of the two Alternative Scenarios chosen for analysis and comparison to the Initial Run Scenario.

The INDEX Model

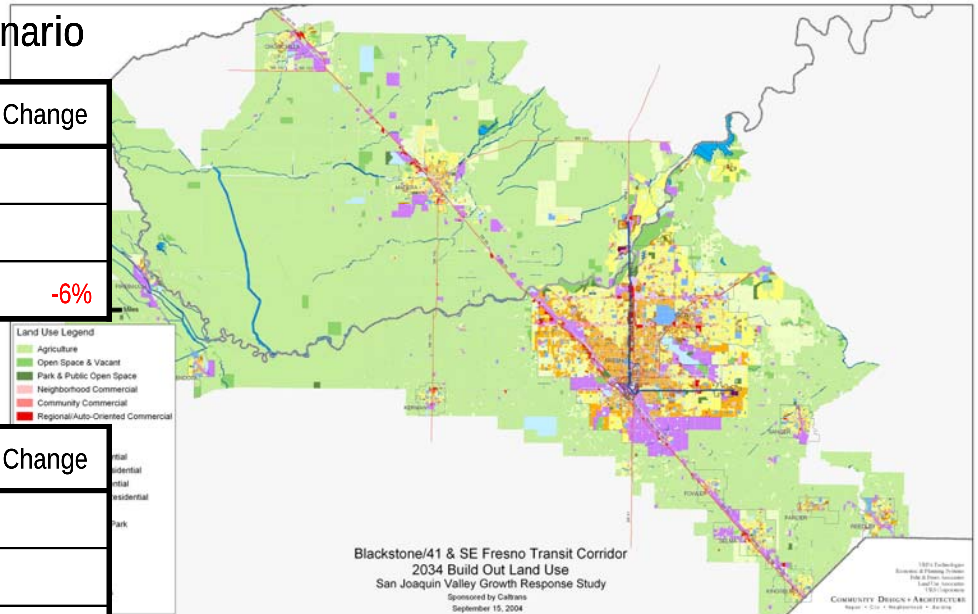
Once the UNION file was prepared, the methodologies that had been developed for assessing the Initial Run and converting the *What If?* outputs to TP+ and INDEX inputs were utilized. The indicator results of the three model runs were compared with a series of maps, table and charts that were presented at the Final workshop**.** Each of these are included in Chapter 5 and below in this Chapter (reference Figures 5-5 through 5-16 in Chapter 5 and Figures 6-4 through 6-13 on the following pages.

FIGURE 6-2
HOUSEHOLDS AND JOBS
2003 AND INITIAL RUN VS ALTERNATIVE 1

- Blackstone/41-Downtown Fresno Scenario (Alt. 1) vs. Initial Run Scenario

Fresno Co.	Households	% Change	Jobs	% Change
Existing 2003	247,800		317,400	
Initial Run	450,300		678,400	
Blackstone/41	462,350	3%	639,100	-6%

Madera Co.	Households	% Change	Jobs	% Change
Existing 2003	27,100		30,700	
Initial Run	83,800		50,600	
Blackstone/41	79,400	-5%	105,550	109%



Land Use - 2034

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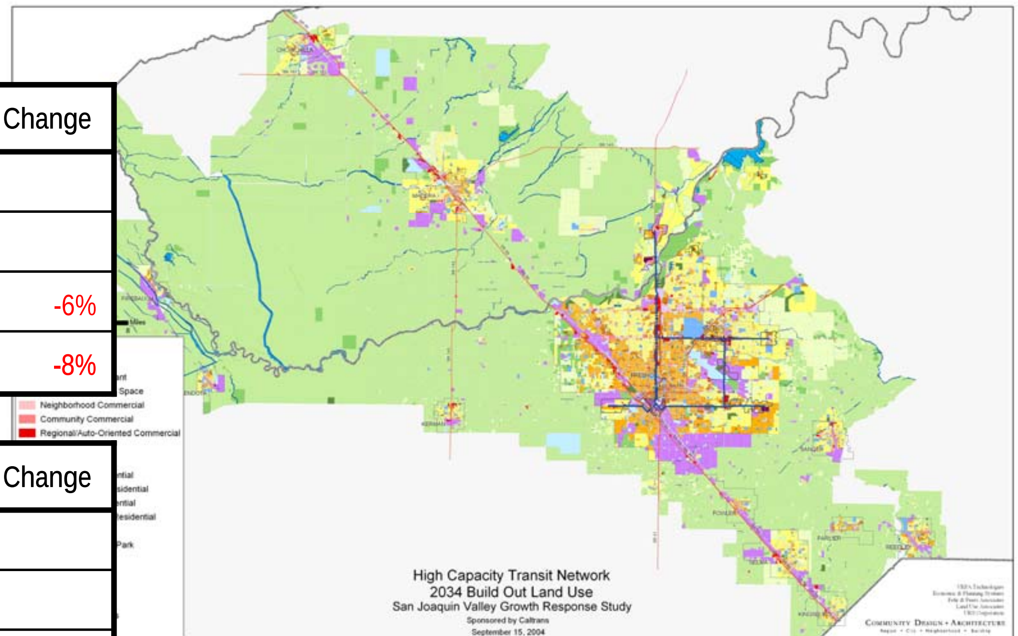
FIGURE 6-3
HOUSEHOLDS AND JOBS
2003 AND INITIAL RUN VS ALTERNATIVES 1 & 2

- High Capacity Transit Network Scenario (Alt. 2) vs. Initial Run Scenario

Fresno Co.	Households	% Change	Jobs	% Change
Existing 2003	247,800		317,400	
Initial Run	450,300		678,400	
Blackstone/41	462,350	3%	639,100	-6%
HCT Network	440,750	-2%	622,600	-8%

Madera Co.	Households	% Change	Jobs	% Change
Existing 2003	27,100		30,700	
Initial Run	83,800		50,600	
Blackstone/41	79,400	-5%	105,550	109%
HCT Network	91,650	9%	117,120	131%



Land Use - 2034

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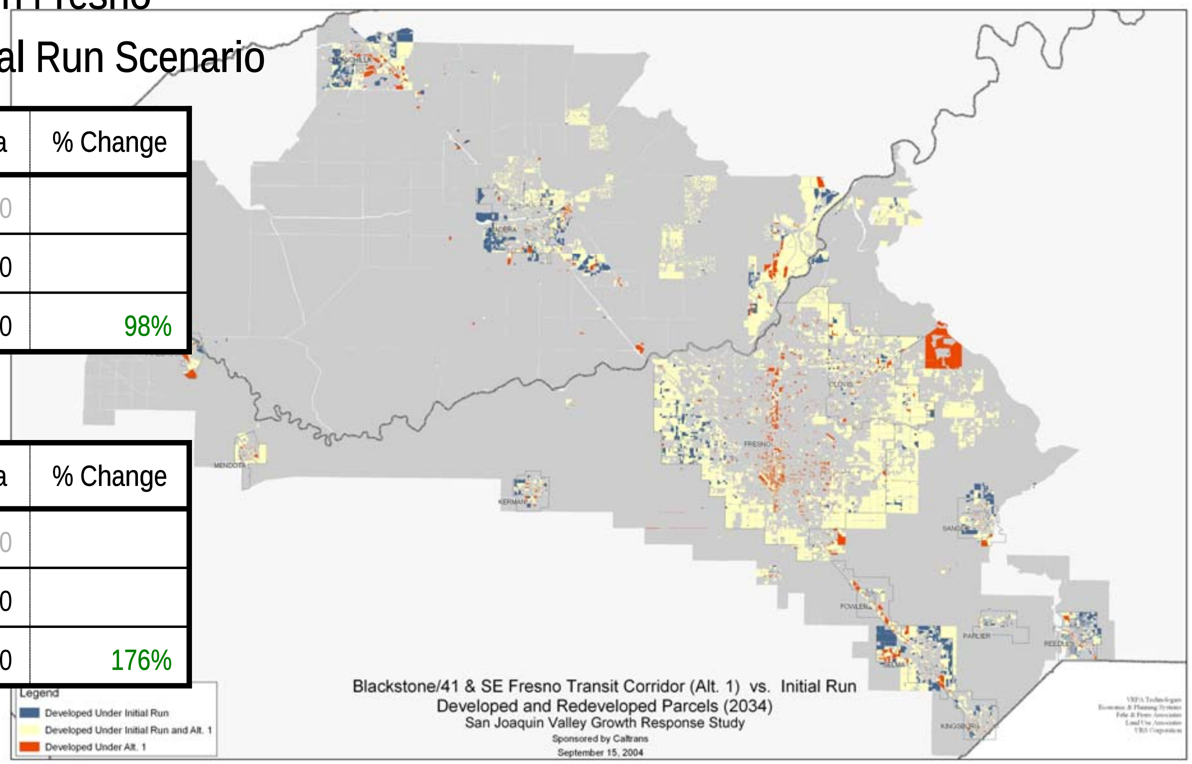
FIGURE 6-4
DEVELOPED AND REDEVELOPED PARCELS
2003 AND INITIAL RUN VS ALTERNATIVE 1

- Blackstone/41-Downtown Fresno Scenario (Alt. 1) vs. Initial Run Scenario

Fresno Co.	"Developable" Land Area	% Change
Existing	70,200	
Initial Run	7,060	
Blackstone/41	14,000	98%

Madera Co.	"Developable" Land Area	% Change
Existing	32,200	
Initial Run	4,100	
Blackstone/41	11,300	176%



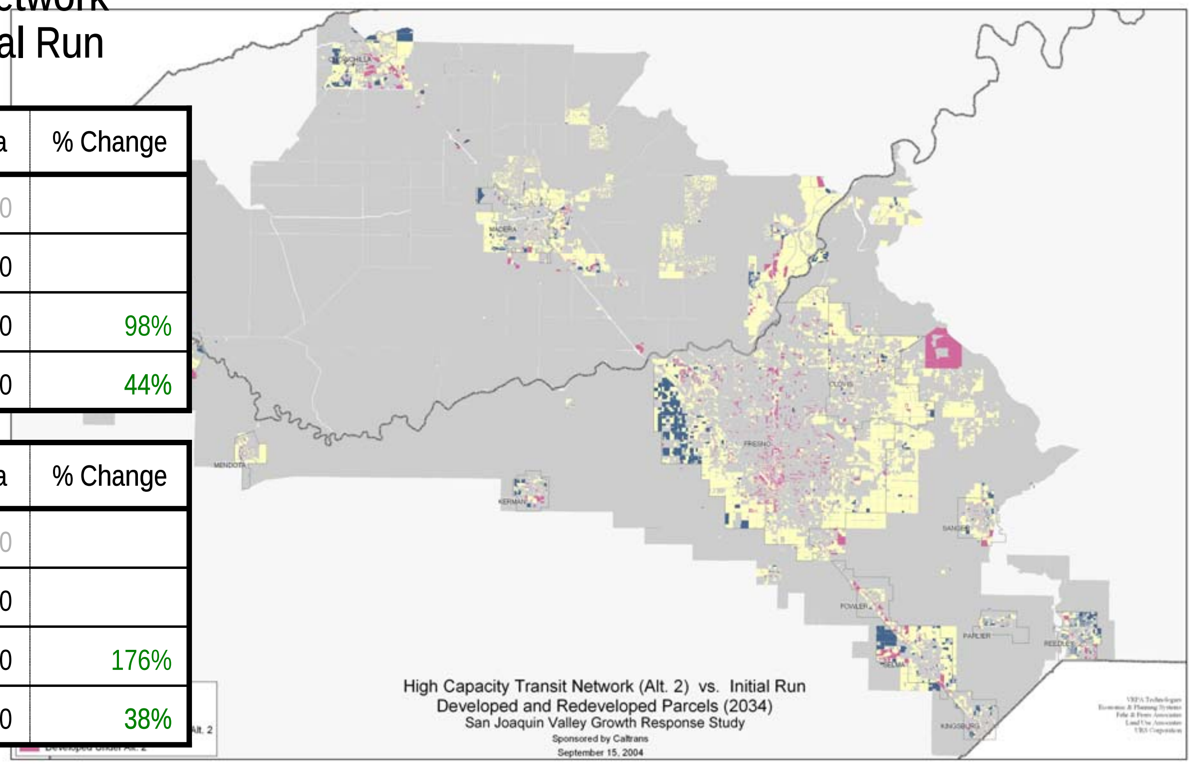
Note: "Developable" Land is vacant, rural residential, agriculture, and open space with urban General Plan Designations.

FIGURE 6-5
DEVELOPED AND REDEVELOPED PARCELS
2003 AND INITIAL RUN VS ALTERNATIVES 1 & 2

- High Capacity Transit Network Scenario (Alt. 2) vs. Initial Run

Fresno Co.	"Developable" Land Area	% Change
Existing	70,200	
Initial Run	7,060	
Blackstone/41	14,000	98%
HCT Network	10,200	44%

Madera Co.	"Developable" Land Area	% Change
Existing	32,200	
Initial Run	4,100	
Blackstone/41	11,300	176%
HCT Network	5,660	38%



Note: "Developable" Land is vacant, rural residential, agriculture, and open space with urban General Plan Designations.

FIGURE 6-6
DEVELOPMENT FOOTPRINT
INITIAL RUN VS ALTERNATIVES 1 & 2

Alternatives 1 and 2 vs. Initial Run

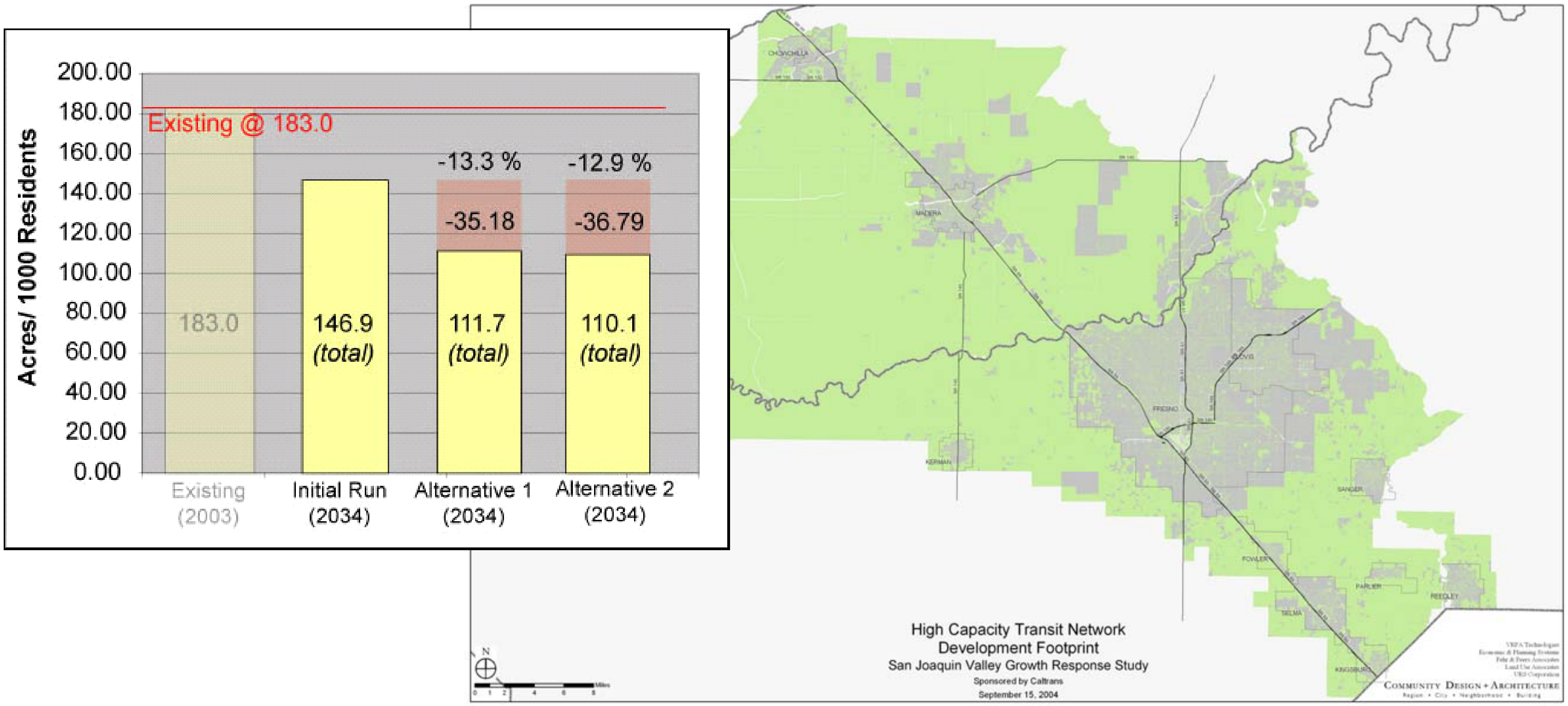


FIGURE 6-7
POPULATION DENSITY
INITIAL RUN VS ALTERNATIVES 1 & 2

- Alternatives 1 and 2 vs. Initial Run

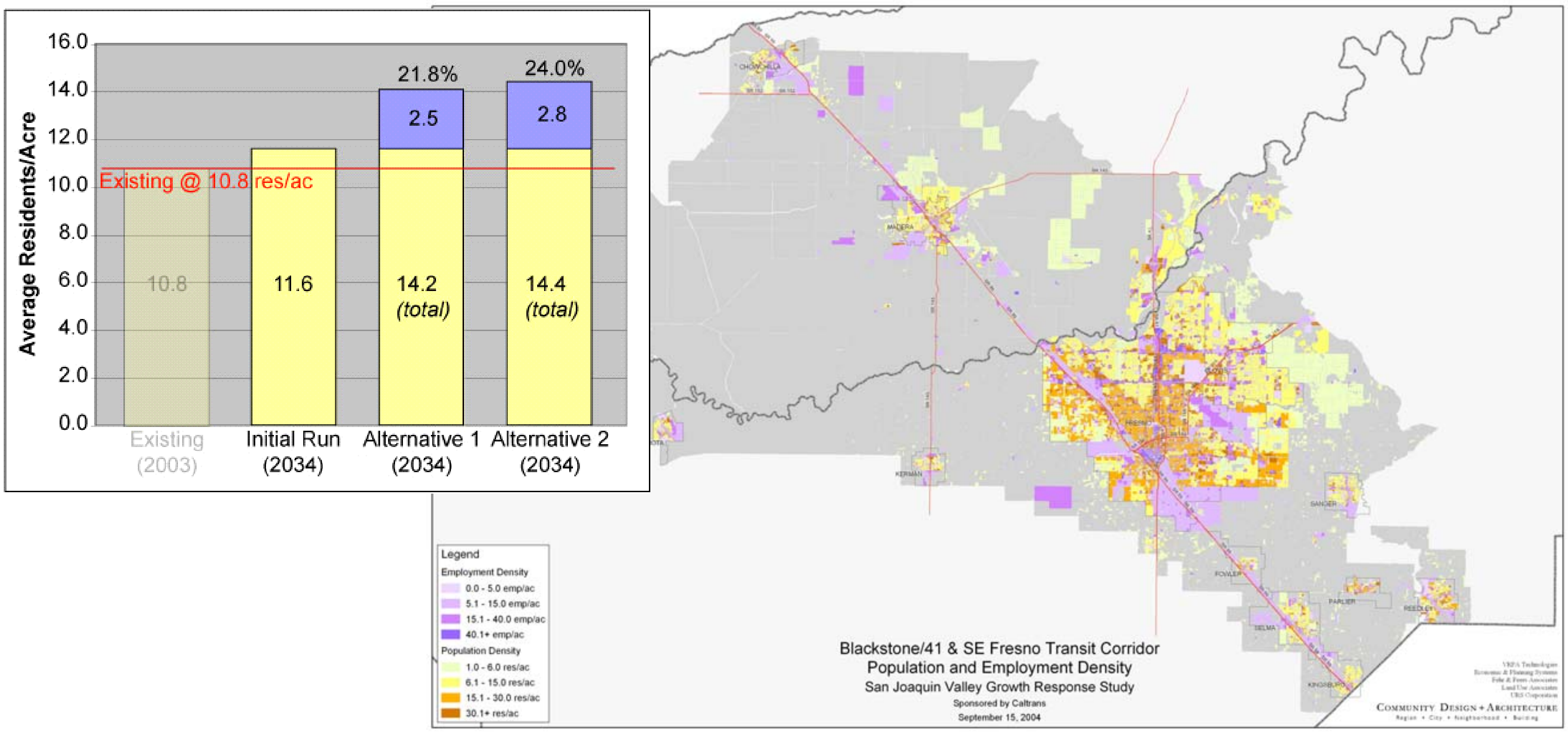


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FIGURE 6-8
EMPLOYMENT DENSITY
INITIAL RUN VS ALTERNATIVES 1 & 2

- Alternatives 1 and 2 vs. Initial Run

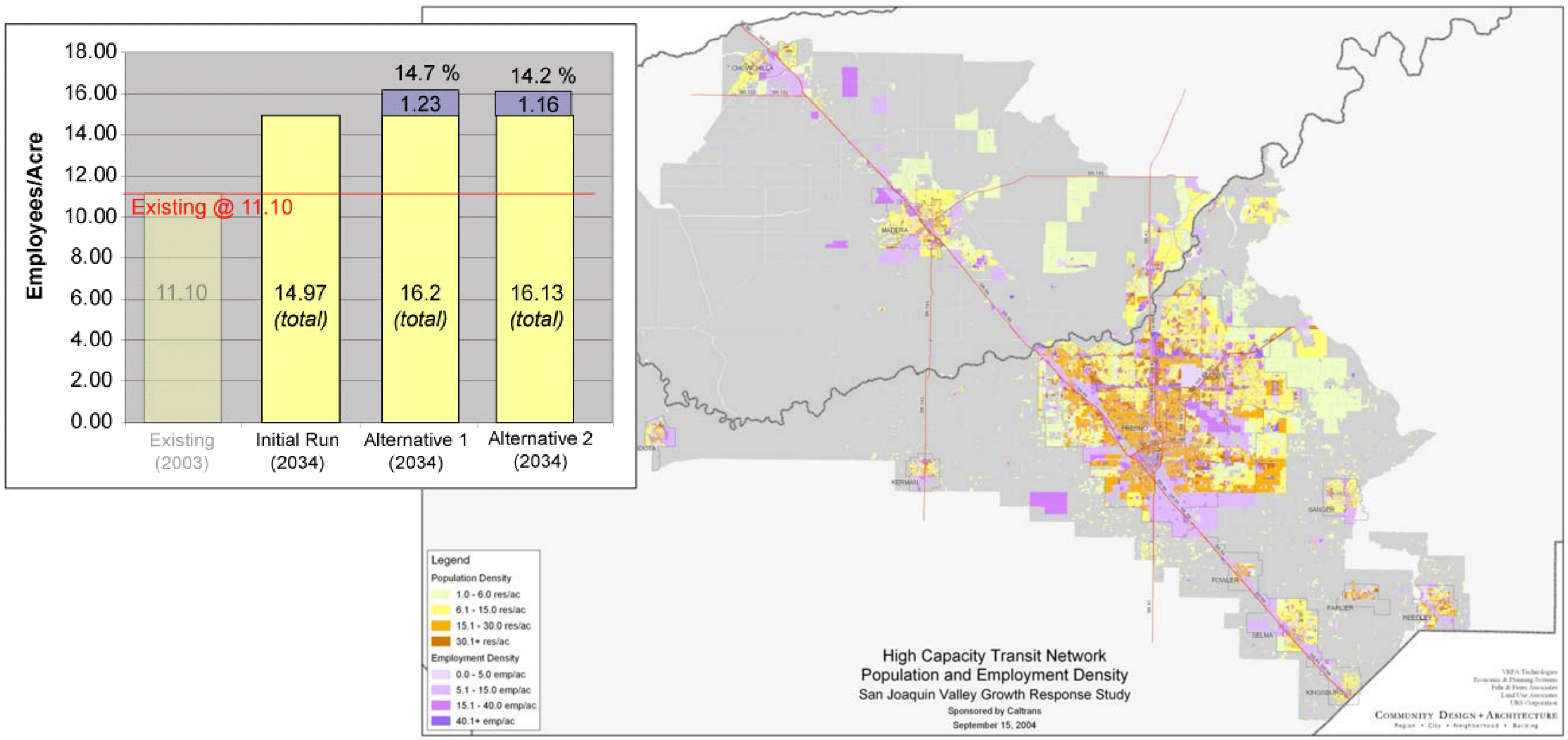

FIGURE 6-9
USE MIX
ALTERNATIVE 1

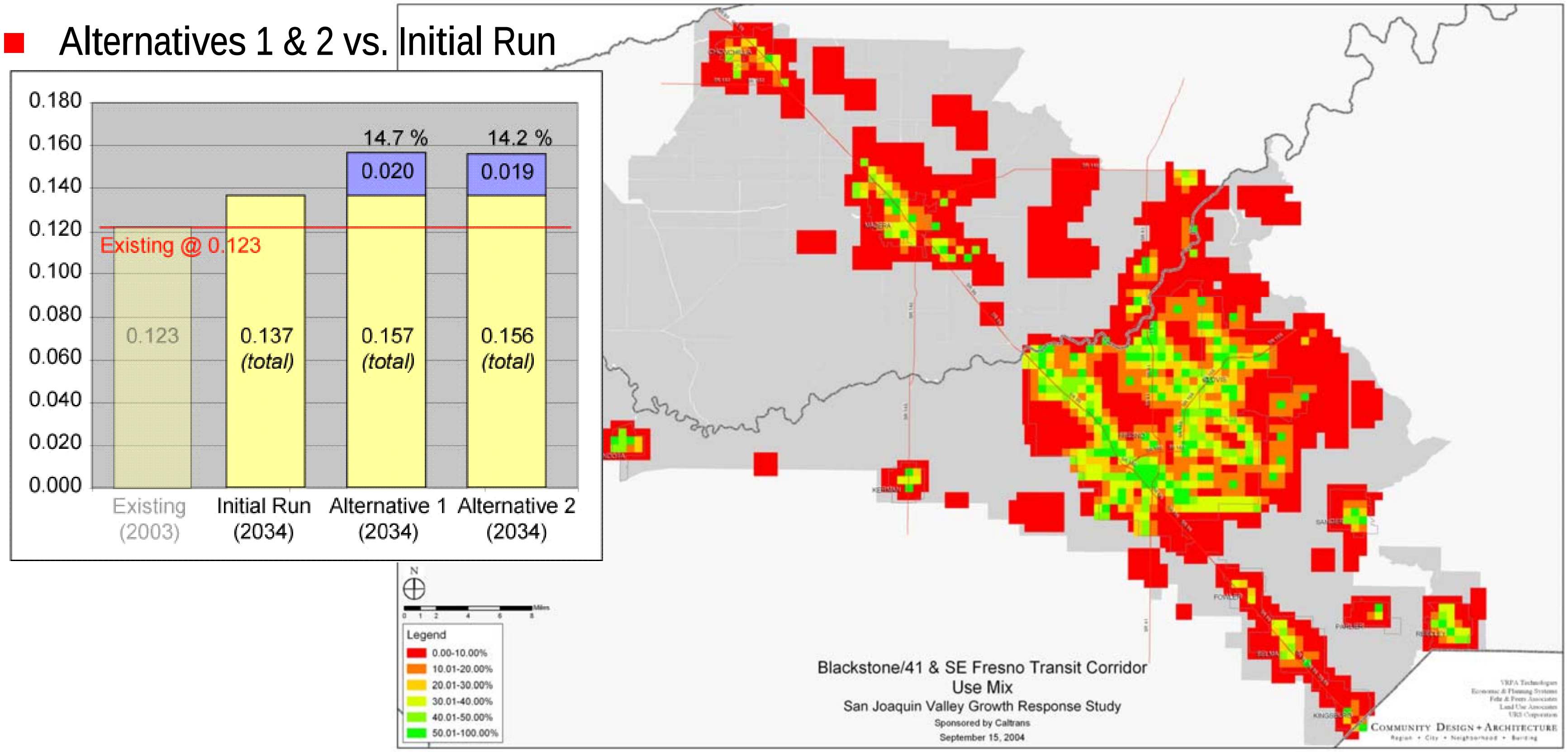

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FIGURE 6-10
USE MIX
ALTERNATIVE 2

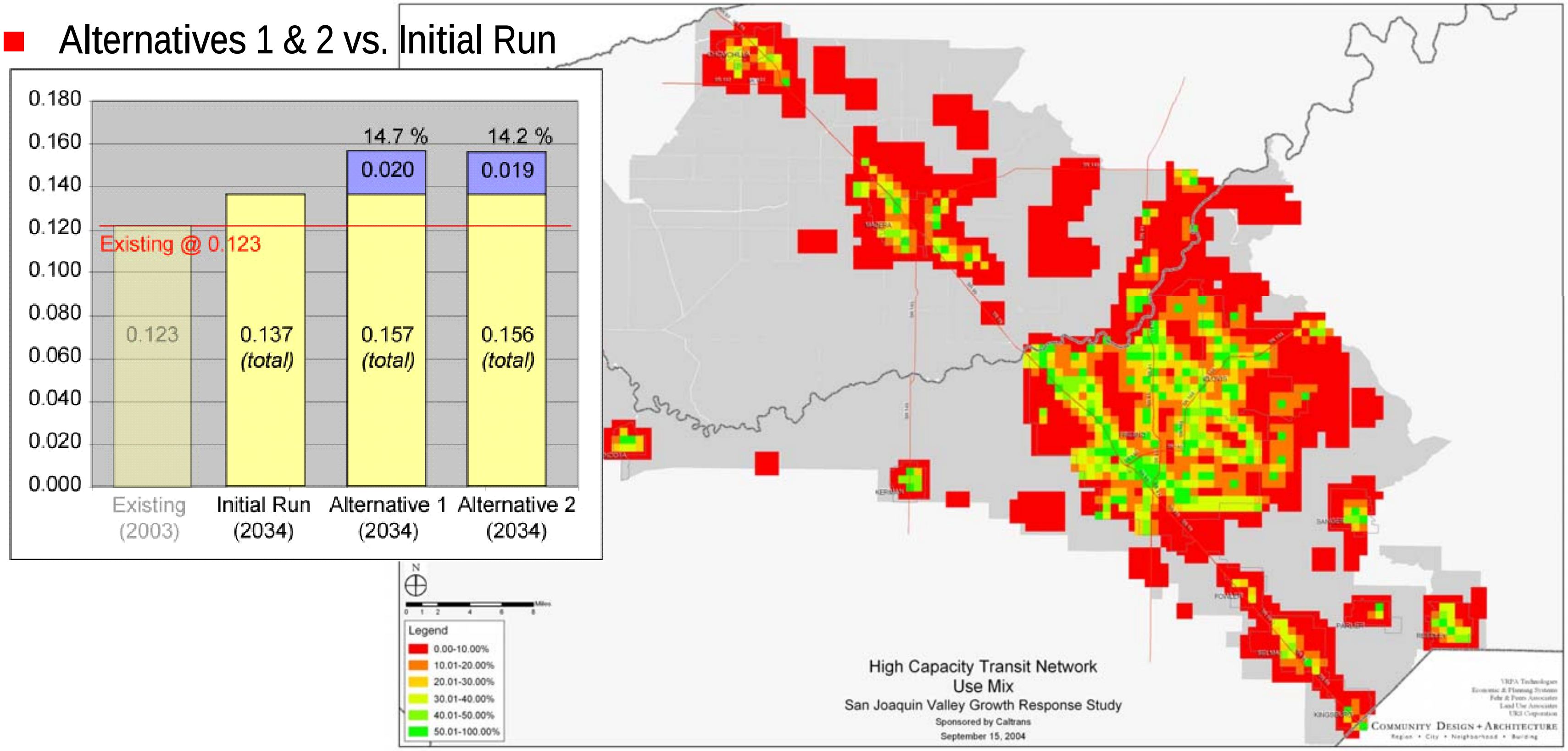


FIGURE 6-11
RESIDENTIAL ADJACENCY TO TRANSIT
ALTERNATIVE 2

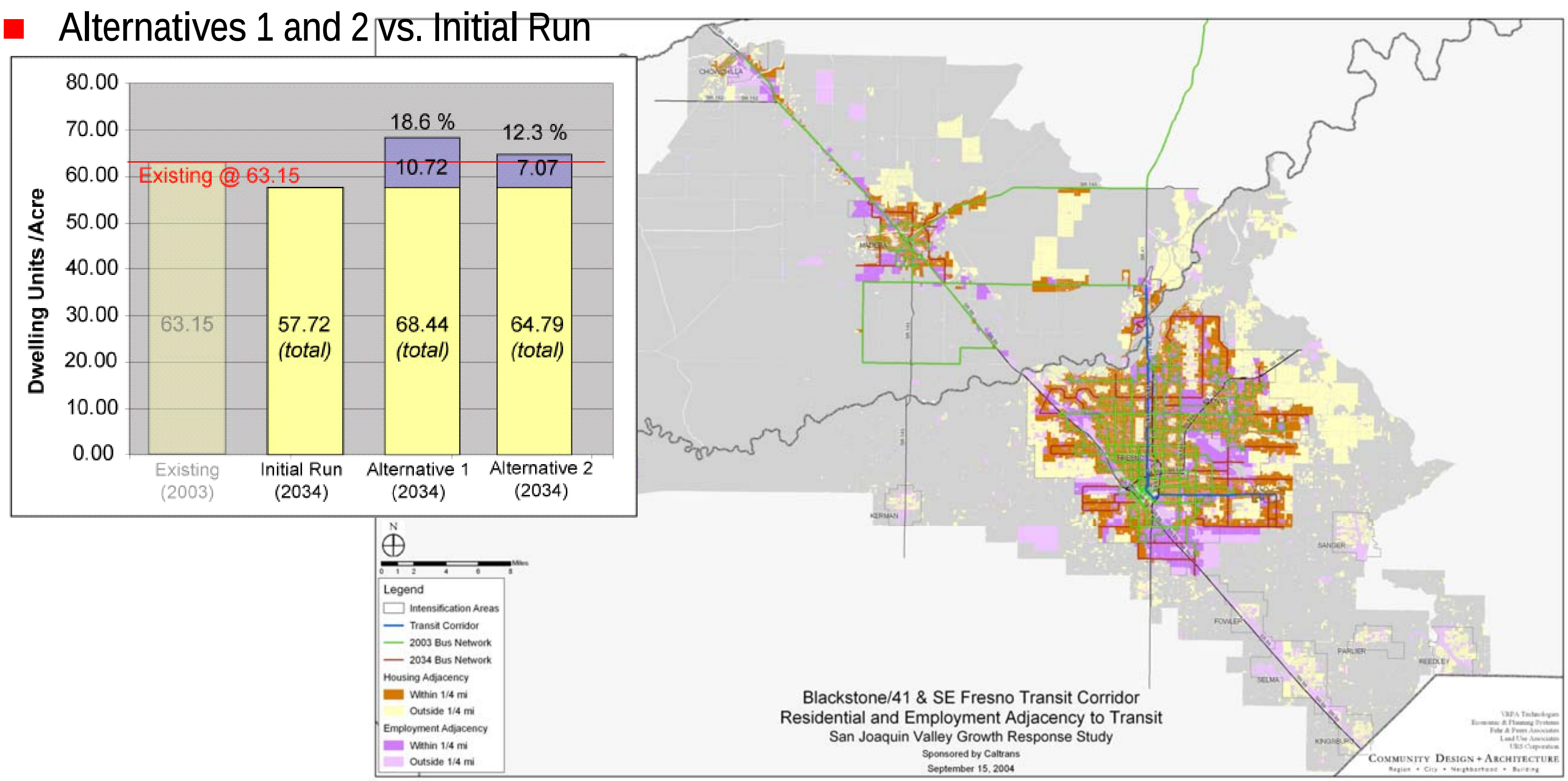
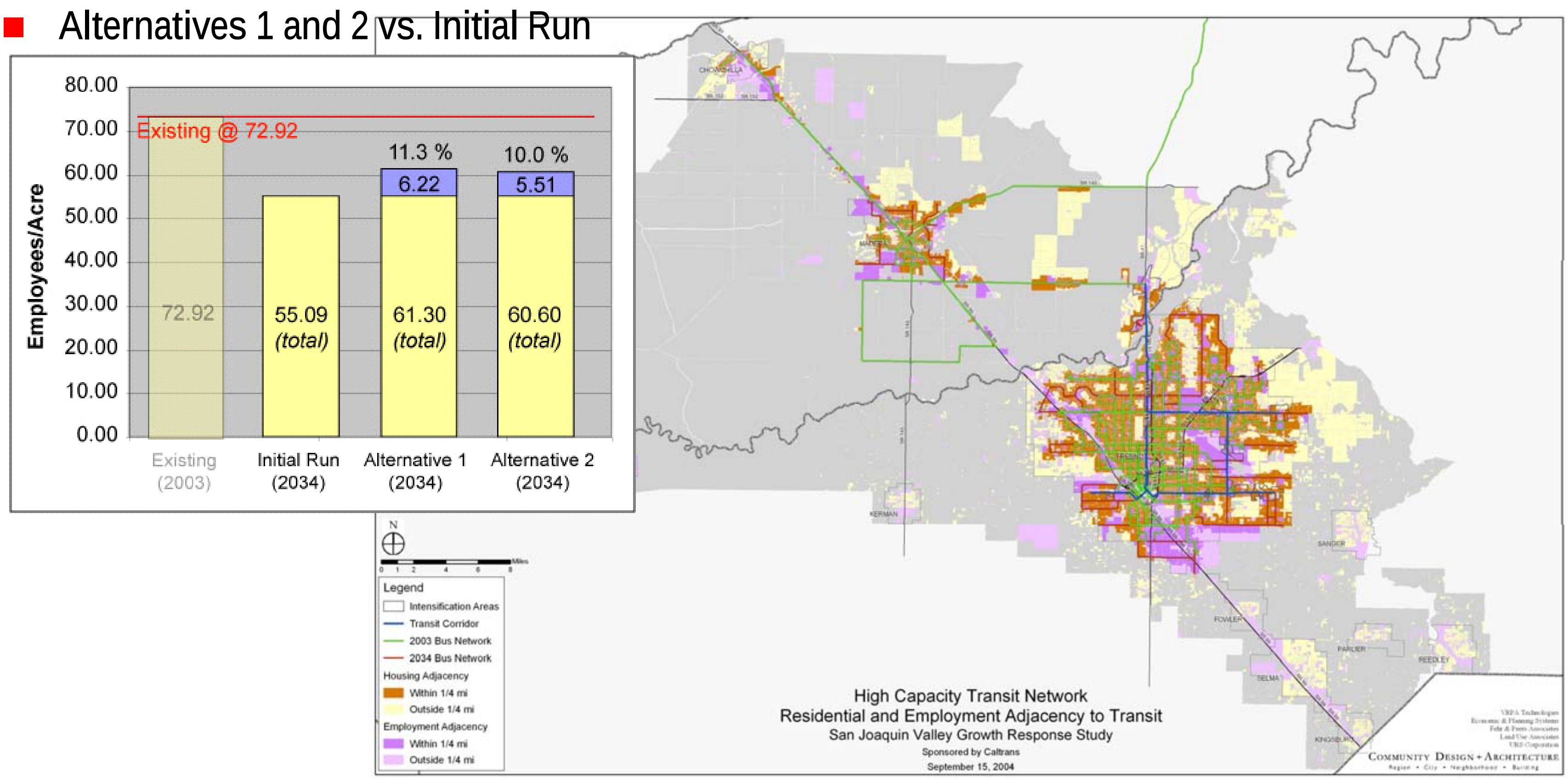


FIGURE 6-12
EMPLOYMENT ADJACENCY TO TRANSIT
ALTERNATIVE 2



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The TP+/4D Model

Tables 6-1 through 6-5 and Figures 6-13 through 6-17 provide a comparison between results of the Initial Run scenario and the two Alternative scenarios. Under Alternative 1, 2034 development levels are kept approximately the same, but development is intensified along a hypothetical Blackstone-Kings Canyon rail corridor, including downtown. Under Alternative two, a larger number of intensification districts are assumed along a more extensive Bus Rapid Transit (BRT) corridor. The intensification districts in Alternative 2 are not as densely developed as compared to intensification districts in Alternative 1.

Data on daily vehicle trips in Table 6-1 and Figure 6-13 indicates that both Alternatives would result in fewer Vehicle Trips in Fresno County. The reduction is twice as great under Alternative 2 as under Alternative 1. Vehicle Trips increase in Madera County (which has only about a fifth as many trips in the Initial Run). This largely reflects the fact that more development is allocated to the Madera County What If? Study Area under both Alternative Scenarios compared to in the Initial Run. Overall, Vehicle Trips in the two County Study Area would decline by 2 percent under Alternative 1 and 4 percent under Alternative 2.

The increase in vehicle trips in the Fresno intensification area is an unintended consequence of concentrating commercial activity in the congested SR 41 corridor. Further interpretation of increases in Vehicle Trips is provided in the section titled *General Discussion Regarding the Performance of Alternatives* later in this chapter.

TABLE 6-1
DAILY VEHICLE TRIPS

	Initial Run	Alternative 1	% Change vs. Initial Run	Alternative 2	% Change vs. Initial Run
Fresno County	4,788,239	4,588,034	-4%	4,421,061	-8%
Fresno County What If? Study Area	4,623,400	4,423,583	-4%	4,255,954	-8%
Fresno County Intensification Area	735,897	1,218,452	66%	1,708,188	132%
Madera County	968,274	1,055,775	9%	1,108,749	15%
Madera County What If? Study Area	859,515	949,192	10%	1,000,552	16%
Regional Total	5,756,513	5,643,809	-2%	5,529,810	-4%

FIGURE 6-13
DAILY VEHICLE TRIPS

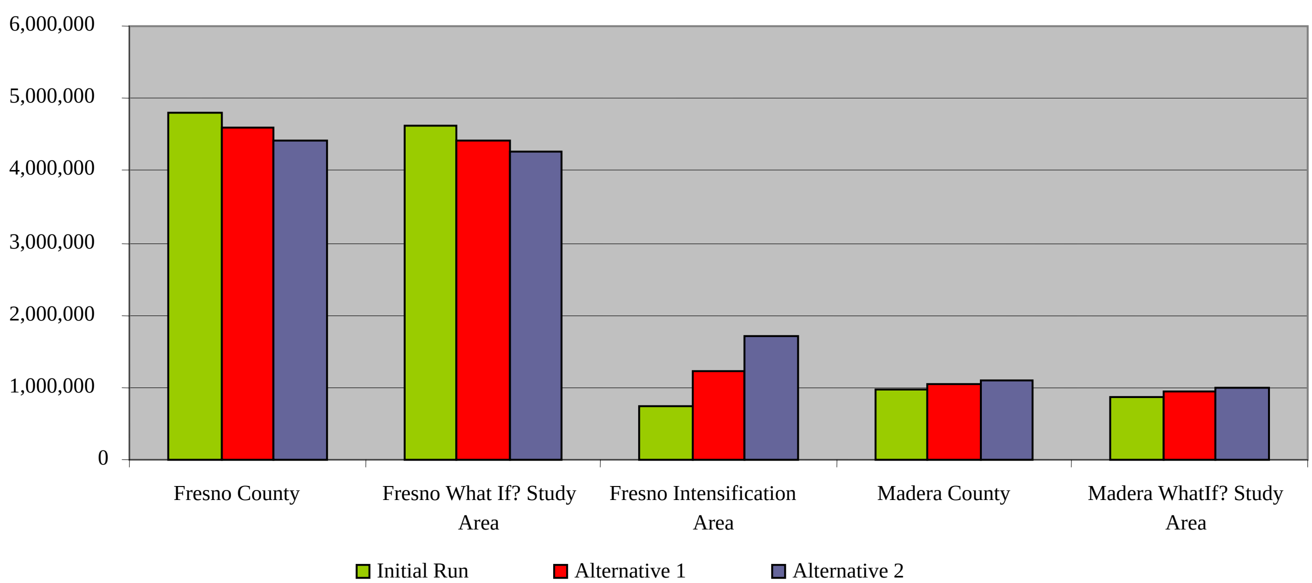


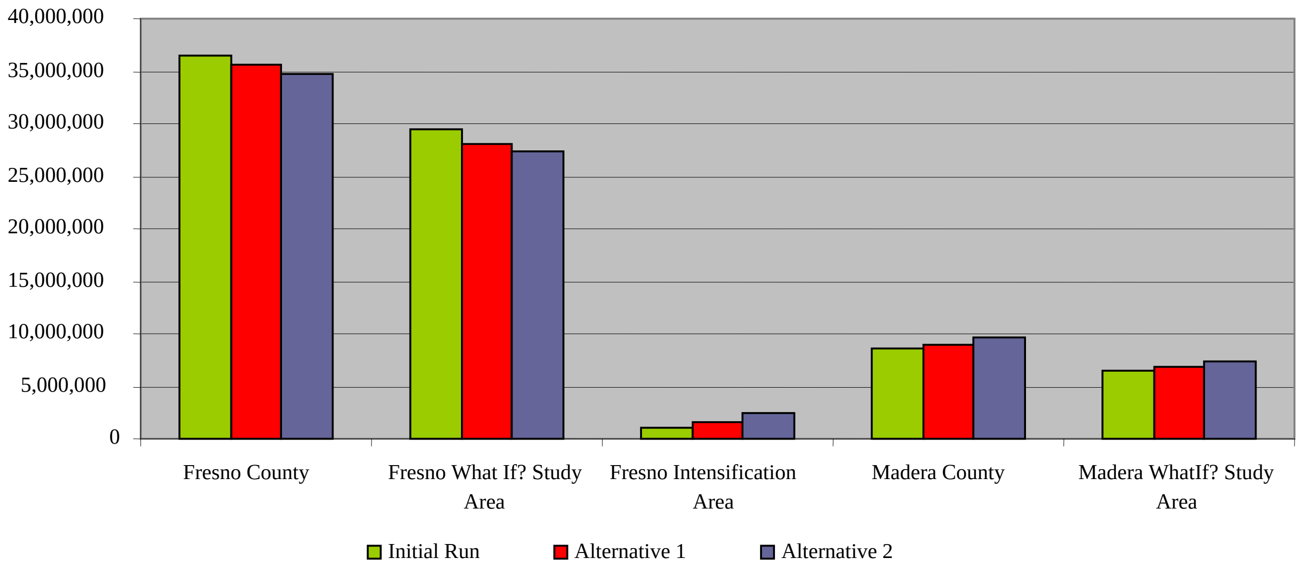
Table 6-2 and Figure 6-14 indicate that both Alternatives would also result in fewer Vehicle Miles Traveled in Fresno County. The reduction is approximately twice as great under Alternative 2 as under Alternative 1. VMT goes up in Madera County (on a much smaller base) reflecting the fact that more development is allocated to the Madera County What If? Study Area under both Alternative Scenarios. Overall, VMT in the two-County Study Area would decline by 1 percent under Alternative 1 and 2 percent under Alternative 2.

The relatively large increase in VMT in the Fresno intensification area is an unintended consequence of concentrating commercial activity in the congested SR 41 corridor. Further interpretation of increases in VMT is provided in the section titled *General Discussion Regarding the Performance of Alternatives* below.

TABLE 6-2
DAILY VEHICLE MILES TRAVELED

	Initial Run	Alternative 1	% Change vs. Initial Run	Alternative 2	% Change vs. Initial Run
Fresno County	36,462,235	35,653,122	-2%	34,787,842	-5%
Fresno County What If? Study Area	29,420,756	28,099,121	-4%	27,302,182	-7%
Fresno County Intensification Areas	1,000,371	1,603,311	60%	2,404,016	140%
Madera County	8,677,118	8,938,910	3%	9,585,887	10%
Madera County What If? Study Area	6,546,114	6,806,707	4%	7,368,256	13%
Regional Total	45,139,353	44,592,032	-1%	44,373,729	-2%

FIGURE 6-14
DAILY VEHICLE MILES TRAVELED (VMT)



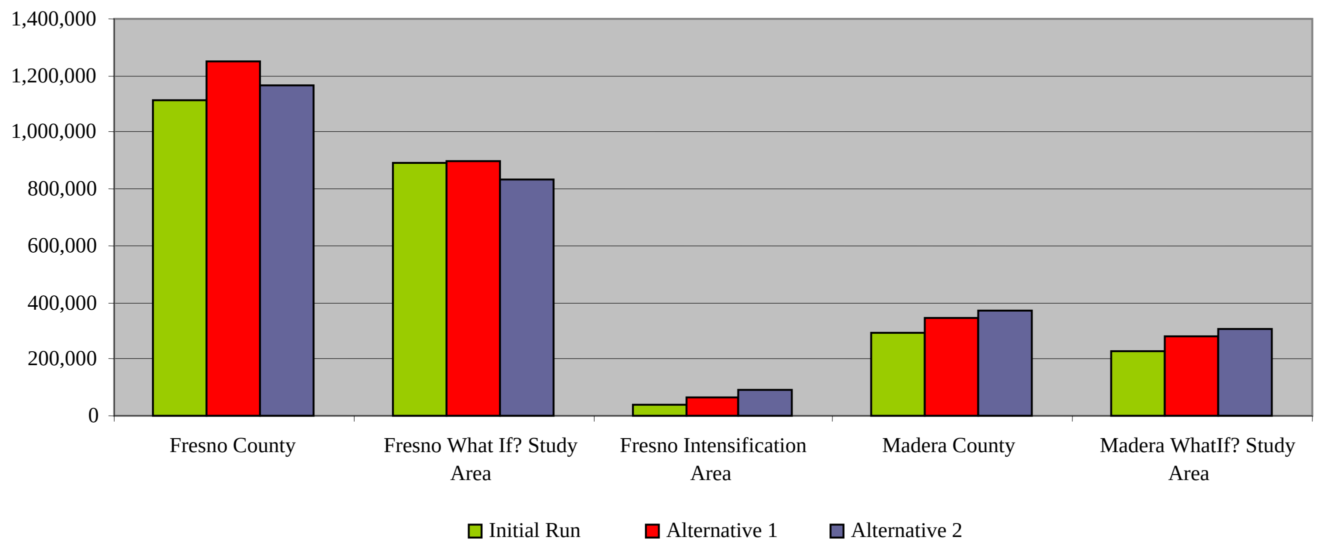
Data on daily Vehicle Hours Traveled in Table 6-3 and Figure 6-15 indicates that, in general, both Alternatives would result in *more* VHT in both counties. The increase is greater under Alternative 1 than under Alternative 2. The fact that Madera County registers a higher increase than Fresno County largely reflects the fact that more development is allocated to the Madera County What If? Study Area under both Alternative Scenarios compared to in the Initial Run, with Alternative 2 seeing significantly higher growth in Madera County. Overall, VHT in the two-county Study Area would increase by 13 percent under Alternative 1 and 10 percent under Alternative 2

The relatively large increase in the Fresno intensification area is an unintended consequence of concentrating commercial activity in the congested SR 41 corridor. Further interpretation of increases in VHT is provided in the section titled *General Discussion Regarding the Performance of Alternatives* below.

TABLE 6-3
DAILY VEHICLE HOURS TRAVELED

	Initial Run	Alternative 1	% Change vs. Initial Run	Alternative 2	% Change vs. Initial Run
Fresno County	1,115,243	1,247,443	12%	1,167,981	5%
Fresno County What If? Study Area	889,193	897,681	1%	834,238	-6%
Fresno Intensification Areas	37,669	63,804	69%	88,799	136%
Madera County	292,121	347,137	19%	374,302	28%
Madera County What If? Study Area	227,944	280,589	23%	303,240	33%
Regional Total	1,407,364	1,594,580	13%	1,542,283	10%

FIGURE 6-15
DAILY VEHICLE HOURS TRAVELED



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Average roadway speed, like VHT, is often used an indicator of congestion. Table 6-4 and Figure 6-16 indicate that, in general, both Alternatives would exhibit slower average roadway speeds in both counties. The increase is greater under Alternative 1 than under Alternative 2. The fact that Madera County registers greater reductions than Fresno County again largely reflects the fact that more development is allocated to the Madera County What If? Study Area under both Alternative Scenarios compared to in the Initial Run, with Alternative 2 seeing a significantly higher level of growth in Madera County. Fresno County will see a greater concentration of traffic on slower speed and congested roads, thus speeds will decline somewhat under each alternative, even though the number of vehicle trips and VMT also decline under both Alternatives.

TABLE 6-4
DAILY AVERAGE SPEED (MILES PER HOUR)

	Initial Run	Alternative 1	% Change vs. Initial Run	Alternative 2	% Change vs. Initial Run
Fresno County	33	29	-12%	30	-9%
Fresno County What If? Study Area	33	31	-6%	33	-
Fresno Intensification Areas	27	25	-7%	27	-
Madera County	30	26	-13%	26	-13%
Madera County What If? Study Area	29	24	-17%	24	-17%

FIGURE 6-16
DAILY AVERAGE SPEED (MILES PER HOUR)

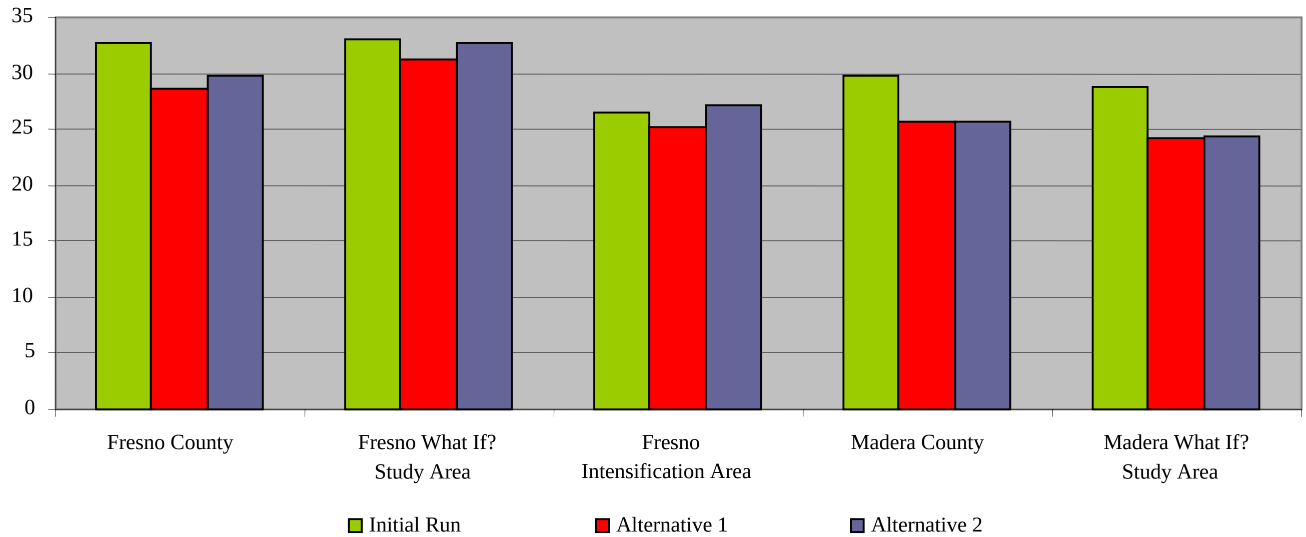
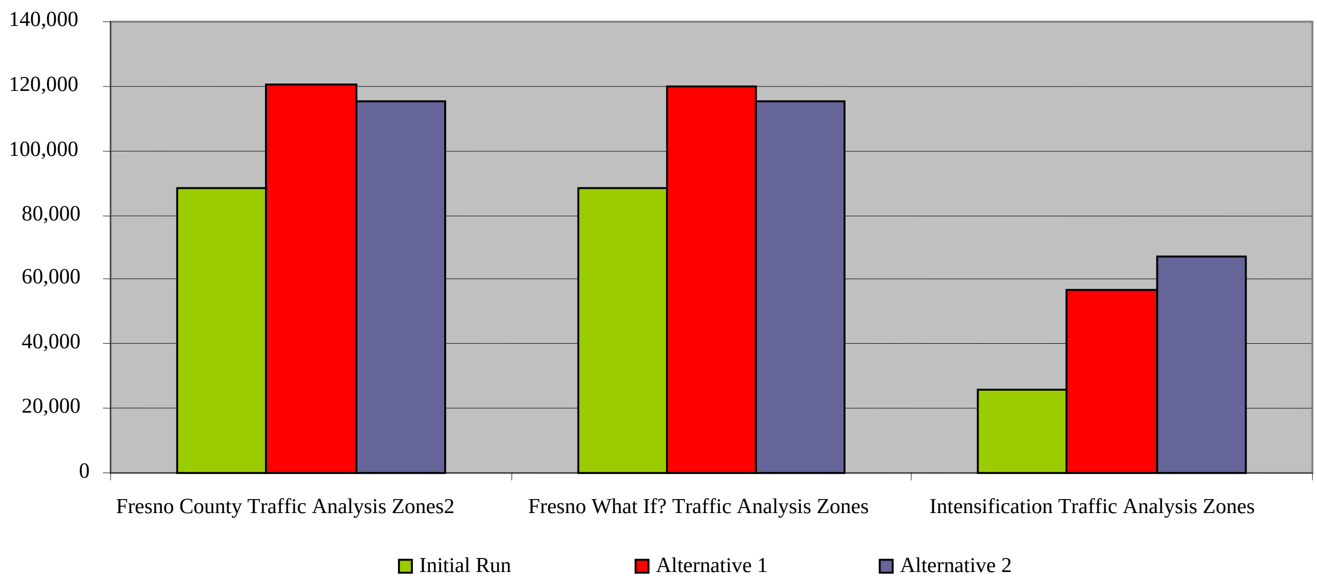


Table 6-5 and Figure 6-17 indicate that both Alternatives would result in significantly more transit ridership compared. Data are shown only for Fresno County zones since only the Fresno County model has a full mode choice model Transit ridership increase is slightly greater under Alternative 1 than under Alternative 2, and would be most significant in the intensification areas under both alternatives. The fact that the intensification area registers a higher increase under Alternative 2 is somewhat misleading, since the intensification areas under Alternative 2 are more numerous under Alternative 2. It should be noted that the increase in transit trips is less than the reduction in Vehicle Trips under both Alternatives. The difference is attributable to increases in walk and bicycle trips, as well as some increase in short transit trips, e.g., within a traffic analysis zone. The mode split model is not sensitive to such short transit trips.

TABLE 6-5
TOTAL DAILY TRANSIT PERSON TRIPS – FRESNO COUNTY

	Initial Run	Alternative 1	% Change vs. Initial Run	Alternative 2	% Change vs. Initial Run
Fresno County	88,425	120,235	36%	115,392	30%
Fresno County What If? Study Area	88,238	120,044	36%	115,201	31%
Fresno Intensification Areas	25,671	57,034	122%	67,304	162%

FIGURE 6-17
TOTAL DAILY TRANSIT PERSON TRIPS



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General Discussion Regarding the Performance of Alternatives

The results for both 2034 alternative scenarios are generally in the expected direction for the Vehicle Trip and Vehicle Miles Traveled indicators. The expected decreases compared to the Initial Run are not large, but given that more than 90 percent of the TAZ's were outside the intensification areas under both Alternatives, the subregional and regional reductions in travel may be considered sizable and significant. Moreover, it should be borne in mind that the 4Ds process for capturing the effects of land use intensification is inherently somewhat conservative. The reduction factors (shown in Appendix A, Table A-1) are based on reductions associated with density and mixed use actually observed in the Sacramento Region. These reductions are applied only where Sacramento household surveys contained sufficient data to prove (statistically) that a reduction in vehicular trip-making occurs. Furthermore, the difficulty in specifying how sidewalk coverage and directness might improve under the Alternatives meant that the trip-reducing effects of such improvements are not reflected in the results.

The Study's goal of keeping employment and population level at approximately the same control totals for the What If? modeling area while intensifying development in central corridors (particularly the congested SR 41 corridor) appears to have perverse effects on Vehicle Hours Traveled and roadway speeds. In part this occurs because the land use balance between residential and non-residential uses in peripheral areas worsens under the alternatives compared to under the Initial Run: peripheral area residents (i.e., outside the intensification areas) must go further to work and shop. In particular, travel to and from the peripheral areas on the slower speed, more congested intensification area roadways in the SR 41 corridor increases vehicular traffic and congestion in this corridor, even though residents and workers in this corridor make fewer vehicle trips.

The contribution of congestion on the SR 41 San Joaquin River bridge that links the two counties is worth noting. The Madera County Model indicates that Alternative 1 increases bridge traffic by more than 80,000 average daily vehicle trips (ADT) and that Alternative 2 increases bridge traffic by more than 70,000 daily trips compared to the Initial Run's 150,000 ADT (which is already above theoretical capacity). Most of the increase in vehicle hours traveled on Madera County roadways is attributable to this extreme bridge congestion. Higher VHT and slower speeds in Madera County under both Alternatives are also partly the result of more development in Madera County compared to the Initial Run; this is again an artifact of the What If? forecast.

The wider dispersal of intensification areas within and away from the SR 41 corridor under Alternative 2 compared to Alternative 1 reduces vehicular traffic and congestion in the intensification areas. The overall transit mode share, though slightly lower than that in Alternative 1, is still 31 percent higher than that in the Initial Run.

Further Details on Transportation Indicators

Appendix B contains further details on the transportation impacts of the future scenarios, including p.m. peak hour results for all 2034 cases (Initial Run, Alternative 1 and Alternative 2).

San Joaquin Valley Growth Response Study, Phase III
Fresno-Clovis-Southeast Madera Region
Demonstration Project

CHAPTER 7 – TOOL BOX ISSUES, RECOMMENDATIONS, AND CONCLUSIONS

In the course of performing the Phase III Study, there were several obstacles to overcome in order to run the scenarios through the models and gauge their relative success at meeting the goals as defined by the Stakeholders that attended the workshops. Many of these problems were related to the state of the GIS data acquired for both Fresno and Madera Counties. Some problems were related to the lack of correspondence between data acquired from the various planning authorities, while others were related to the function and interface of the models. Depending on the scale at which future planning exercises will require use of these models, some of these issues will be more of a concern than others. However, if efforts are made to provide a comprehensive, standardized, and detailed GIS data set, the majority of issues encountered would be minimized or resolved, and the power of these models could be more fully realized resulting in a more streamlined process. Following are the main issues that will need to be addressed and an approach to resolving the issues is outlined.

Data Issues

Data Acquisition

It was quite a challenge for the Study Team to obtain a comprehensive geographic representation of the existing land use patterns, household and employment demographics related to the land uses, and the transportation network that serves them. Similarly, a comprehensive and adequately detailed geographic representation of existing land use and transportation policies for the entire Study Area was also a challenge. Although this is not an uncommon problem in many regions of the State and the country, some regions are making significant progress in developing a comprehensive database to carry out effective local and regional planning. A few examples are the Sacramento Region here in California, the Portland Metropolitan Region in Oregon, the Phoenix metropolitan area in Arizona, and the Salt Lake City Region in Utah. It was also difficult to gain an understanding of what GIS and other information was available for use. The formation of a central clearinghouse for geographic, demographic, and environmental data would greatly facilitate this process and resolve this and many of the issues outlined below.

Data Standardization and Correspondence

An inordinate amount of time was spent during the Phase III Study researching, translating, modifying, standardizing, and reconciling the various land use, demographic, and environmental datasets. For example, the scenarios were developed based on parcel-level data because this level of detail was needed for the INDEX indicators to be as meaningful as possible. However, demographic projections and inputs for the TP+ traffic models use a TAZ geography, which cannot be easily reconciled back to the parcel level. The lack of detail in the existing TAZ files for existing and 2025 future made it impossible to gauge the local jurisdictions understanding of the potential for revitalization, and redevelopment within the Study Area. Therefore, this Study did not account for potential revitalization and redevelopment of existing development. This is of prime importance if the Study Area is looking to preserve valuable agricultural land while maintaining its preference for low-density development and encouraging higher-density, highly accessible housing development.

To effectively estimate the potential for revitalization, additional information is needed such as number of units if residential use, square foot of use if non-residential, number of stories, etc. Both Fresno COG and MCTC should work with local jurisdictions to define a methodology for improving the detail of the information that is gathered during their periodic updates of demographic data for regional modeling purposes. It can be expected that overtime the Study Area can develop more parcel specific information that will facilitate the utility of *What If?* and INDEX.

The Phase III Study utilized four modeling tools, which required the preparation of data in different ways. If the tools are to be used on a regular basis, a procedural standard should be developed to convert the collected data into the input formats for each of the models. A checklist of inputs required for the models should be maintained before data collection. This will help focus the acquisition of data from different sources.

Resolving these issues would require a degree of cooperation by communities when updating their General Plans and other policies. The counties or Fresno COG and MCTC could act as a central clearinghouse and coordinate a cooperative effort to effectively create standards for classification and translation of data. The effort should allow communities flexibility to plan at the local level while also facilitating an effective process for regional planning. Standards could be implemented when updates to General Plans and other plans and policy documents are developed in order to streamline the collection of data. Resolving this issue is critical if the Study Area is hoping to model the impacts of growth at the regional level using *What If?*, INDEX, or other land use allocation and assessment tools.

Level of Detail

Further, some General Plan policies lacked the detail needed to define land use capacity in a meaningful way for use with the allocation model. For example, many jurisdictions define the needs for civic uses, like parks and schools, based only on ratios (i.e., acres of park per 1,000 residents) rather than defining the desired distribution or specific locations of these important uses. This made it difficult to allocate these types of jobs to the geography or to evaluate accessibility to parks and schools using INDEX. In addition, detailed sidewalk data would allow INDEX to do proximity analyses, which would calculate true waking distance from residences and employment areas to amenities and needed services. The INDEX model could analyze such indicators as adjacency of households to community health care services and everyday needs such as grocery stores. Both of these indicators were of prime importance to many stakeholders in attendance at the workshops.

Communities in the Study Area are also beginning to bring a higher level of sophistication in their land use plans by encouraging mixed-use development. This complexity will require a set of more specific definitions that will allow for a fairly accurate representation of the growth potential if definitions for the types of uses and their mix, and densities are clearly defined. Planning to a greater level of detail, as well as providing this detail in a GIS useable digital format, would greatly facilitate a more sophisticated level of local as well as regional assessment and analysis as part of the planning process.

Model Issues and Recommendations

Both *What If?* and INDEX are relatively new models, as are the other land use allocation and assessment tools that are available in the market today. These models are updated frequently and at times require creativity on the part of the modeler. This is similar to the experience with early transportation models and the newer generation of GIS-based transportation models that are just reaching the market today. The following are some recommendations regarding the future use of the *What If?* and INDEX models.

What If?

Prior to creating the UNION file, it is advisable to reduce the number of features to be processed through the model by using the sliver removal tool in ArcINFO or other non-ESRI, third-party "plug-ins." This same process should also be used to remove features that contain unusable data, such as residual or insignificant polygons. Performing this "pre-processing" of the GIS files will help to minimize processing errors.

It is expected that the next update of *What If?* will expand the number of land use categories from 16 to 80, which will facilitate the utility of the program. But standardization of land uses and clarity in definition of land use policies by jurisdictions within the Study Area will still greatly improve the utility of the program.

INDEX

Large GIS data files (over 20,000 features) may slow down the data processing time in INDEX, therefore, fewer features may allow INDEX to function more efficiently. Given this, larger scale studies can be assessed in subareas and/or with a geography that aggregates parcels. Jurisdictions should look to use INDEX at a variety of scales from the neighborhood to citywide to regional levels.

Similar to all new analysis tools, such as new traffic model systems or updates, the limitations discussed above for both the *What If?* and INDEX models may reduce their output efficiency. The accuracy of modeling results for both *What If?* and INDEX should be checked to ensure that they are accurate. Also, checking for updates of the tools should be done on a regular basis, as the developers are constantly upgrading their methodologies and adding new features.

Transportation Models

Based on the transportation results for the two alternatives, several additional future scenario analyses appear worth pursuing, including the following:

1) Consider greater capacity for the SR 41 San Joaquin River bridge corridor beyond the current four lanes. Given the high demand in the corridor, it would be rewarding to explore options that favor high-occupancy modes.

2) In lieu of (or in tandem with) providing more bridge capacity, reallocate land uses north and south of SR 41 San Joaquin River bridge for greater land use balance.
3) It may also be useful to develop categories of local-serving, pedestrian-oriented retail Trip Generation for use in the intensification areas (or use Fresno's "CBD Retail trip rate throughout intensification zones; this rate is 51.4 instead of 56.6 daily person trips per employee). New retail categories would require substantial revisions to the TP+ models.

Conclusion

In conclusion, the What If?, INDEX, and transportation/4D modeling tools provide the opportunity to vastly improve the understanding of the interrelationships between land use and transportation and the benefits of smart growth. Overtime, required data and data gathering practices will ease the functionality of the models for the Study Area and each of the local jurisdictions interested in applying the models to further enhance their planning process and help the jurisdictions make better informed decisions regarding growth and development.

CHAPTER 8 – TOOL BOX TRAINING, PRESENTATION TO THE COUNTY MODELING GROUPS, AND NEXT STEPS

Tool Box Training

The Study Team provided limited Tool Box training to staff of Fresno COG and MCTC, as well as other interested agencies on June 24, 2004 and November 19, 2004. The first training session was held in Lafayette at the offices of a Study Team member. That training focused on the results of the Initial Run and how the WhatIf? and INDEX models were developed for the Phase III Study. The 2nd training session was held in Oakland and focused on the details of the What-If? modeling application. A final session was held in Fresno at Caltrans District 6 Manchester offices and focused on more detailed application of the INDEX tool.

Given the complexity of the models, additional training will be required and the extent of training will vary significantly in the short- and long-term. In the short-term, training will be significant (up to 6 months) given the need to research, translate, modify, standardize, and reconcile the various land use, demographic, and environmental datasets. For example, the scenarios were developed based on parcel-level data because this level of detail was needed for the INDEX indicators to be as meaningful as possible. However, demographic projections and inputs for the TP+ traffic models use a TAZ geography, which cannot be easily reconciled back to the parcel level. The lack of detail in the existing TAZ files for existing and the future year made it impossible to gauge the local jurisdictions' understanding of the potential for revitalization, and redevelopment within the Study Area.

In the long-term, the extent of training will be significantly reduced as Fresno COG and MCTC continue or begin the process of developing parcel-level and use-specific datasets in GIS.

Presentations to the County Modeling Groups

Members of the Study Team, in consultation and coordination with Fresno COG, presented the final Phase III Study Tools to the Fresno COG Model Steering Committee in May 2005. That presentation focused on the benefits of the tools, the short- and long-term application of the tools, and Fresno COG, local agency, and other staff resources needed to apply the tools. MCTC has requested a similar presentation at its upcoming July 2005 Technical Advisory Committee meeting. A copy of the presentation is provided on the Website at *www.dot.ca.gov/dist6/projects.htm*.

CHAPTER 9 – PRESENTION OF THE FINAL PHASE III STUDY AND THE TOOL BOX

Members of the Study Team presented the Final Phase III Study process and Tool Box to the Counties of Fresno and Madera (May 2005) and to the City Councils of the Cities of Fresno (June 2005) and Madera (May 2005). As of the date of this Report, all the presentations were complete except to the Clovis City Council. (Revise only if meeting with Clovis takes place before Report is finalized)

There were a number of comments and questions made by the elected officials during each of the presentations. A majority of the comments focused on the current availability of the models or Tool Box, where the Tool Box would be held and maintained, the type and size of planning projects that the Tool Box could address, when the two regional modeling agencies (Fresno COG and MCTC) are planning to develop parcel level GIS datasets compatible with the WhatIf? and INDEX input requirements, the amount of training that will be required to run the models, and specific questions related to the type of information that the Tool Box models can provide as a project is evaluated using the Tools.

APPENDIX A

PROCESS USED TO INTEGRATE RESULTS OF THE FRESNO COG & MCTC TP+ MODELS

1. Land use files were developed for each model based on the What If? land use forecasts. A series of database operations summed parcel-based projections by traffic analysis zones (TAZ). Thus land use was consistent between the two models. Land use was converted from residential and employment acres to households and employees in the appropriate TP+ land use categories for each of the two models.

2. Sets of TAZs of interest were defined for use in summarizing results. The basic TAZ sets are:

   a) Fresno County Model zones in the detailed What If? Modeling Area.

   b) Madera County Model zones in the detailed What If? Modeling Area. Fresno and Madera County Model zones outside the detailed What If? Modeling Area (by County)

3. The Madera County Model was augmented to include a step producing p.m. peak hour assigned trip table using peak hour factors and directional split factors from the Fresno County Model.

4. The two models' volumes were compared along the Fresno-Madera County boundary and on other major roads links representing external gateways to the modeling area.

5. At the direction of staff at both Fresno COG and MCTC, Madera County Model forecast volumes along the Madera/Fresno County model boundary and between zone sets (b) and (c) were used to adjust Fresno County Model internal – external and external-internal (IX and XI) trip ends; these are used as input to the trip generation module of the Fresno County model.

6. For the Alternative land use scenarios, 4D adjustments were applied to the production-attraction trip tables for both models by trip purpose. (See Appendix B for details).

7. Each model was run with its adjusted trip table. Interzonal travel distances were skimmed.
8. For zones in Madera County Model, the model's adjusted trip table was multiplied by its distance skim and sum all zonal trip exchanges to get vehicle trips (VT) and vehicle miles (VMT) totals.

9. A select link analysis was performed with the Madera County Model on all boundary crossings (see Step 4) to produce Fresno and Madera County Model VT and VMT for all crossings and in both directions.

10. For zones in Fresno County Model the assigned trip table was multiplied by the Fresno County model's distance skim for all zonal trip exchanges not including IX and XI trips calculated using the Madera County model in step 9.

    The foregoing steps allow the calculation of VT and VMT for any zone or set of zones in either model with the advantage that Fresno County Model trips to/from Madera County have IX and XI trips determined by the Madera County Model rather than the Fresno County Model external gateway zone connector distances. These Madera County Model trips are consistent with the Fresno County Model in regard to land use inputs.

APPENDIX B

PHASE III STUDY "4D" (DENSITY, DIVERSITY, DESIGN AND DESTINATIONS) PROCESS DETAILS

1. *Input Data from What If? Model and other GIS sources*

For each geographic area: 1) Traffic Analysis Zone [TAZ], or 2) Set of TAZs.

- Street centerline file (including local streets) with geo–coded TAZ centroid locations, for use in determining:
  - Street centerline miles
  - Path traces, measuring route directness among adjacent TAZs
- Sidewalk miles
- Population
- Total Employment
- Retail Employment
- Build-able acres (excluding water bodies, steep slopes, etc)
- Built acres (area used for urban or suburban land uses)

Ideally, all 7 items need to be specified for both the initial run (the base case) and for each future Scenario case, although item 6 is generally to be the same in both Base and Scenario. For the Growth Response exercise, no changes are assumed in street and sidewalk density between the baseline 2034 scenario and Alternative 2034 scenarios. This was in response to a lack of data on sidewalks, but also in recognition of the difficulties in quantifying changes in street and sidewalk density in areas where no detailed plans exist.

2. *Input Data from Fresno and Madera County Model TP+ Pre-Analysis*

For each of the transportation networks applied to the 2034 land use, the following data is needed by TAZ:

- TAZ Population
- TAZ Employment Total
- TAZ Retail Employment
- Person Trips (PT-P) Produced by Purpose
- Person Trips (PT-A) Attracted by Purpose

3. Input Elasticities, from Fehr & Peers research findings

Sacramento studies by Fehr & Peers and other sources form the basis for elasticities for:

- Design Elasticities for VT and VMT by Trip Purpose
- Density Elasticities for VT and VMT by Trip Purpose
- Diversity Elasticities for VT and VMT by Trip Purpose
- Destinations Elasticities for VT and VMT by Trip Purpose

These elasticities are fixed parameters for the analysis of development alternatives. Trip elasticities are shown below in Table B-1.

4. Calculate Independent Variables for Base Case (Initial Run)

For each geographic area calculate:

- Network density = Street centerline miles per square mile
- Sidewalk coverage = sidewalk miles per street-side miles (2 x centerline miles)
- Route directness = network distance/ airline distance, for representative origin/ destination pairs
- Design Index = a linear function of Network density, Sidewalk coverage, and Route directness
- Density Index = (population + employment)/ buildable acres
- Diversity Index = function of TAZ or cell retail and non-retail employment
- Destinations Index = function of travel-time scalar for TAZ or cell and scalars of productions and attractions for all TAZ's or cells.

For the Initial Run, items 1, 2, and 3 are derived from existing mapping of each TAZ (or adjoining TAZ or consultant team input if subject TAZ is currently empty). We may assume that trend-line mirror existing development form in certain existing TAZs.

Fehr and Peers devised formulae to use for each index calculation (items 4, 5, 6, and 7.). Because the TP+ models were determined to be adequate for estimating the effects of concentrations of regional destinations, the Destinations Index was not employed for this planning exercise.

TABLE B-1
4-D TRIP ELASTICITIES BY TRIP PURPOSE FROM SACRAMENTO REGIONAL ANALYSIS

4D Elasticities from SACOG Household Surveys	Net Res. Density	Net Emp. Density	Jobmix Diversity	Index Design	HBW Destinations	Non_HBW Destinations
Vehicle Trip Elasticities						
HBO	-7.0 %		0.0 %	- 3.2 %		-25.2 %
HBW	0.0 %		0.0 %	0.0 %	-19.7 %	
NHB		-33.9 %	-46.2 %	0.0 %		-82.2 %

Notes:
- Shading indicates insufficient data to calculate elasticity
- Design elasticities not used, due to difficulty of specifying for 2034
- Destinations elasticities not used as TP+ deemed sufficient

Ceiling and Floor Values

Maximum allowable difference between Initial Run and test Scenario for any of the four Ds: +/-400%

Maximum allowable 4D adjustment for any TAZ for any individual trip purpose:

Ceiling	+50%
Floor	-50%

Minimum & Maximum Vehicle Trips per Household:

Ceiling	7.5
Floor	3.0

5. Calculate Independent Variables for "Scenario" Case

For same geographic areas calculate:

- Network density = Street centerline miles per square mile
- Sidewalk coverage = sidewalk miles per street-side miles (2 x centerline miles)

- Route directness = network distance/ airline distance, for representative origin/ destination pairs
- Design Index = a linear function of Network density, Sidewalk coverage, and Route directness
- Density Index = (population + employment)/ buildable acres
- Diversity Index = function of TAZ or cell population and employment, and regional population and employment
- Destinations Index = function of travel-time scalar for TAZ or cell and scalars of productions and attractions for all TAZ's or cells.

Fehr and Peers developed formulae to use for each calculation based on prior research in Sacramento and elsewhere. Again, because the TP+ models were determined to be adequate for estimating the effects of concentrations of regional destinations, the Destinations Index was not employed for the Growth Response Study.

For the Scenario case, the TAZ value is an area-weighted average of the 2000 value for the percentage of the TAZ already developed in 2000 and the user specified assumption for the percentage of the TAZ being developed between 2000 and 2040.

6. Compute Percentage 4D Difference between Initial Run and Scenario

For each TAZ or cell compute percent difference between Base Case (Initial Run) and Scenario (Alternatives 1 and 2) for: Density Index, Diversity Index, Design Index and Destinations Index.

7. Compute Percent Difference in Trips and Miles, and Resulting Trips and Miles

- Compute percentage difference in trips and miles. For each TAZ or cell apply Density, Diversity, Design, and Destinations elasticities, respectively, to percent difference between Initial Run and Scenario for: Density Index, Diversity Index, Design Index and Destinations Index.

- Apply percentage differences to TAZ or cell Scenario VT and VMT to determine VT and VMT adjusted to account for 4D's.

- Sum TAZ's in a pre-specified sub-regions (geographic corridors) to produce summaries of corridor-specific results.

- Sum all TAZ’s or cells to get regional VT and VMT

- Compare with Scenario VT and VMT with Initial Run VT and VMT on a TAZ, corridor, and regional total basis.

San Joaquin Valley Growth Response III

Results from Planning Models: Fresno County Model 2034 and Madera County Model 2034: Initial Run Land Use

Model Area		Daily Auto Travel[3]						PM Peak Hour Auto Travel[3]					
		VT[4]	VMT[5]	Miles/ Trip	VHT[6]	Minutes / Trip	Average Miles/ Hour	VT[4]	VMT[5]	Miles/ Trip	VHT[6]	Minutes / Trip	Average Miles/ Hour
Fresno COG Model	Fresno County Roadways[1]	4,788,239	36,462,235	7.6	1,115,243	14	33	447,955	3,717,324	8.3	191,505	26	19
	Fresno County What If? Study Area Roadways	4,623,400	29,420,756	6.4	889,193	12	33	432,203	3,006,280	7.0	164,333	23	18
	Fresno Intensification Area Roadways	735,897	1,000,371	1.4	37,669	3	27	68,508	95,773	1.4	7,049	6	14
Madera County Model	Madera County Roadways	968,274	8,677,118	9.0	292,121	18	30	93,848	844,370	9.0	28,914	18	29
	Madera County What If? Study Area Roadways	859,515	6,546,114	7.6	227,944	16	29	83,618	656,131	7.9	23,168	17	28

Model Area		Work Transit				Non-Work Transit				Total Daily Transit	
		Person Trips		Minutes/Trip		Person Trips		Minutes/Trip		Person Trips	Minutes/ Trip
		Drive Access	Walk Access	Drive Access	Walk Access	Drive Access	Walk Access	Drive Access	Walk Access		
Fresno COG Model	Fresno County Traffic Analysis Zones[2]	0	22,910	NA	52	0	65,515	NA	47	88,425	48
	Fresno County What If? Traffic Analysis Zones	0	22,871	NA	51	0	65,367	NA	47	88,238	48
	Intensification Traffic Analysis Zones	0	7,078	NA	47	0	18,593	NA	41	25,671	43

Model Area		Daily Auto		Daily Transit		Daily Walk		All Modes		Percent by Mode		
		Work	**Non-Work**	**Work**	**Non-Work**	**Work**	**Non-Work**	**Work**	**Non-Work**	**Auto**	**Transit**	**Walk**
Fresno COG Model	Fresno County Traffic Analysis Zones[2]	0.180	0.820	0.261	0.739	0.072	0.928	0.178	0.822	0.964	0.010	0.026
	Fresno County What If? Traffic Analysis Zones	0.180	0.820	0.261	0.739	0.070	0.930	0.178	0.822	0.964	0.011	0.025
	Intensification Traffic Analysis Zones	0.205	0.795	0.277	0.723	0.115	0.885	0.205	0.795	0.959	0.021	0.020

1. Roadway measures are based on model network link data and select link matrices.
2. Traffic analysis zone measures are based on model trip tables.
3. Auto travel for each area excludes thru-trips, which have both origin and destination outside the area. All measures apply within the boundary of each area; the external part of an i-x or x-i trip is not included.
4. The number of trips with origin or destination in the model area.
5. Link distance x daily volume, summed over all links in model area.
6. Link congested time x daily volume, summed over all links in model area.

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San Joaquin Valley Growth Response III 9/13/2004
Results from Planning Models: Fresno County Model 2034 and Madera County Model 2034: Alt 1 Land Use

Model Area		Daily Auto Travel[3]						PM Peak Hour Auto Travel[3]					
		VT[4]	VMT[5]	Miles/ Trip	VHT[6]	Minutes/ Trip	Average. Miles/ Hour	VT[4]	VMT[5]	Miles/ Trip	VHT[6]	Minutes/ Trip	Average. Miles/ Hour
Fresno COG Model	Fresno County Roadways[1]	4,588,034	35,653,122	7.8	1,247,443	16	29	429,777	3,655,273	8.5	203,898	28	18
	Fresno County What If? Study Area Roadways	4,423,583	28,099,121	6.4	897,681	12	31	413,863	2,877,318	7.0	165,703	24	17
	Fresno Intensification Area Roadways	1,218,452	1,603,311	1.3	63,804	3	25	114,031	152,816	1.3	12,299	6	12
Madera County Model	Madera County Roadways	1,055,775	8,938,910	8.5	347,137	20	26	102,562	876,830	8.6	34,818	20	25
	Madera County What If? Study Area Roadways	949,192	6,806,707	7.2	280,589	18	24	92,515	689,199	7.5	28,888	19	24

Model Area		Work Transit				Non-Work Transit				Total Daily Transit	
		Person Trips		Minutes/Trip		Person Trips		Minutes/Trip		Person Trips	Minutes/ Trip
		Drive Access	Walk Access	Drive Access	Walk Access	Drive Access	Walk Access	Drive Access	Walk Access		
Fresno COG Model	Fresno County Traffic Analysis Zones[2]	439	34,443	28	41	1,261	84,093	25	40	120,235	40
	Fresno County What If? Traffic Analysis Zones	438	34,403	28	41	1,261	83,941	25	40	120,044	40
	Intensification Traffic Analysis Zones	248	16,628	26	35	566	39,592	24	35	57,034	35

Model Area		Daily Auto		Daily Transit		Daily Walk		All Modes		Percent by Mode		
		Work	Non-Work	Work	Non-Work	Work	Non-Work	Work	Non-Work	Auto	Transit	Walk
Fresno COG Model	Fresno County Traffic Analysis Zones[2]	0.178	0.822	0.292	0.708	0.070	0.930	0.177	0.823	0.959	0.015	0.026
	Fresno County What If? Traffic Analysis Zones	0.177	0.823	0.292	0.708	0.068	0.932	0.176	0.824	0.959	0.016	0.025
	Intensification Traffic Analysis Zones	0.167	0.833	0.297	0.703	0.083	0.917	0.169	0.831	0.947	0.028	0.025

1. Roadway measures are based on model network link data and select link matrices.
2. Traffic analysis zone measures are based on model trip tables.
3. Auto travel for each area excludes thru-trips, which have both origin and destination outside the area.
   All measures apply within the boundary of each area; the external part of an i-x or x-i trip is not included.
4. The number of trips with origin or destination in the model area.
5. Link distance x daily volume, summed over all links in model area.
6. Link congested time x daily volume, summed over all links in model area.

San Joaquin Valley Growth Response III 9/13/2004
Results from Planning Models: Fresno County Model 2034 and Madera County Model 2034: Alt 2 Land Use

Model Area		**Daily Auto Travel**[3]						**PM Peak Hour Auto Travel**[3]					
		VT[4]	**VMT**[5]	**Miles/ Trip**	**VHT**[6]	**Minutes/ Trip**	**Average Miles/ Hour**	**VT**[4]	**VMT**[5]	**Miles/ Trip**	**VHT**[6]	**Minutes/ Trip**	**Average Miles/ Hour**
Fresno COG Model	Fresno County Roadways[1]	4,421,061	34,787,842	7.9	1,167,981	16	30	414,293	3,537,238	8.5	180,108	26	20
	Fresno County What If? Study Area Roadways	4,255,954	27,302,182	6.4	834,238	12	33	398,490	2,781,486	7.0	144,105	22	19
	Fresno Intensification Area Roadways	1,708,188	2,404,016	1.4	88,799	3	27	158,937	227,587	1.4	14,348	5	16
Madera County Model	Madera County Roadways	1,108,749	9,585,887	8.7	374,302	20	26	108,022	944,771	8.8	37,295	21	25
	Madera County What If? Study Area Roadways	1,000,552	7,368,256	7.4	303,240	18	24	97,839	748,505	7.7	30,981	19	24

Model Area		**Work Transit**				**Non-Work Transit**				**Total Daily Transit**	
		Person Trips		**Minutes/Trip**		**Person Trips**		**Minutes/Trip**		**Person Trips**	**Minutes/ Trip**
		Drive Access	**Walk Access**	**Drive Access**	**Walk Access**	**Drive Access**	**Walk Access**	**Drive Access**	**Walk Access**		
Fresno COG Model	Fresno County Traffic Analysis Zones2	482	31,487	27	40	1,163	82,260	23	37	115,392	37
	Fresno County What If? Traffic Analysis Zones	482	31,447	27	40	1,163	82,109	23	37	115,201	37
	Intensification Traffic Analysis Zones	290	17,552	25	36	598	48,865	21	31	67,304	32

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Model Area		Daily Auto		Daily Transit		Daily Walk		All Modes		Percent by Mode		
		Work	Non-Work	Work	Non-Work	Work	Non-Work	Work	Non-Work	Auto	Transit	Walk
Fresno COG Model	Fresno County Traffic Analysis Zones[2]	0.180	0.820	0.279	0.721	0.070	0.930	0.178	0.822	0.959	0.015	).026
	Fresno County What If? Traffic Analysis Zones	0.180	0.820	0.279	0.721	0.067	0.933	0.178	0.822	0.959	0.016	).026
	Intensification Traffic Analysis Zones	0.158	0.842	0.266	0.734	0.060	0.940	0.158	0.842	0.952	0.022	).026

1. Roadway measures are based on model network link data and select link matrices.
2. Traffic analysis zone measures are based on model trip tables.
3. Auto travel for each area excludes thru-trips, which have both origin and destination outside the area.

All measures apply within the boundary of each area; the external part of an i-x or x-i trip is not included.

4. The number of trips with origin or destination in the model area.
5. Link distance x daily volume, summed over all links in model area.

Link congested time x daily volume, summed over all links in m

Appendix C and Appendix D are saved separately from the San Joaquin Valley Growth Response Study – Phase III Final Report. Please see Appendix C – EPS Marketing Report and Appendix D – Polling Results.